

**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	GMA101	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN I	3	0	0	3
2	GMA102	URBAN CONSERVATION AND PRACTICE	2	0	2	3
3	GMA103	TRADITIONAL AND CONTEMPORARY LANDSCAPES	3	0	0	3
4	GMA111	SUSTAINABLE AND GREEN BUILDING DESIGN	2	0	6	4
STUDIO						
1	GMA112	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	GMA201	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN II	3	0	0	3
2	GMA202	PERFORMANCE EVALUATION IN BUILDINGS	2	0	2	3
3	GMA203	SERVICES IN HIGH RISE BUILDINGS	3	0	0	3
4		PROFESSIONAL ELECTIVE-I	3	0	0	3
5		PROFESSIONAL ELECTIVE-II	3	0	0	3
STUDIO						
1	GMA211	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	GMA301	EMERGING PRACTICES IN HOUSING	2	0	2	3
2	GMA302	RESEARCH METHODOLOGIES IN ARCHITECTURE	3	0	0	3
4		PROFESSIONAL ELECTIVE-III	3	0	0	3
5		PROFESSIONAL ELECTIVE-IV	3	0	0	3
STUDIO						
1	GMA312	ADVANCED ARCHITECTURAL DESIGN STUDIO II	0	0	12	6
2	GMA311	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	GMA411	THESIS	0	0	22	11
2	GMA401	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	GMA001	BUILDING MANAGEMENT AND CONTROL SYSTEMS	PE	3	0	0	3
2	GMA002	APPROPRIATE TECHNOLOGIES AND SUSTAINABLE CONSTRUCTION	PE	3	0	0	3
3	GMA003	ARCHITECTURE AND CRITICAL THEORY	PE	3	0	0	3
4	GMA004	GIS MODELLING IN URBAN PLANNING	PE	3	0	0	3
5	GMA005	ANTHROPOLOGY AND ARCHITECTURE	PE	3	0	0	3
6	GMA006	MATERIAL CONSERVATION	PE	3	0	0	3
7	GMA009	URBAN LANDSCAPE DESIGN	PE	3	0	0	3
8	GMA007	LANDSCAPE ECOLOGY AND PLANNING	PE	0	0	6	3
9	GMA010	WEB DESIGN AND PORTFOLIO PRODUCTION	PE	3	0	0	3
10	GMA008	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.	GMA101	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN I	PC	3	3	0	0	3
2	GMA102	URBAN CONSERVATION AND PRACTICE	PC	3	2	0	2	3
3	GMA103	TRADITIONAL AND CONTEMPORARY LANDSCAPE	PC	3	3	0	0	3
4.	GMA111	SUSTAINABLE AND GREEN BUILDING DESIGN	PC	3	2	0	6	4
5	GMA112	URBAN DESIGN STUDIO	PC	8	2	0	6	6
6.	GMA201	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN II	PC	3	3	0	0	3
7	GMA203	SERVICES IN HIGH RISE BUILDINGS	PC	3	3	0	0	3
8	GMA211	ADVANCED ARCHITECTURAL DESIGN STUDIO I	PC	6	0	0	12	6
9	GMA301	EMERGING PRACTICES IN HOUSING	PC	3	2	0	2	3
10	GMA302	RESEARCH METHODOLOGIES IN ARCHITECTURE	PC	3	3	0	0	3
11	GMA312	ADVANCED ARCHITECTURAL DESIGN STUDIO II	PC	8	0	0	6	3
12	GMA411	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.	GMA202	PERFORMANCE EVALUATION IN BUILDINGS	PAEC	3	2	0	2	3
2.	GMA401	BUILDING INFORMATION MODELLING	PAEC	6	0	0	6	3
3.	GMA311	DISSERTATION	PAEC	6	0	0	6	6

GMA101 CONTEMPORARY PROCESSES IN ARCHITECTURE DESIGN I L T P/SC
3 0 03

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 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 its 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 IV GEOMETRIES 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

OUTCOMES:

- Understanding of the effect of contemporary theories of media on contemporary architectural design.
- Understanding of various contemporary design process and their relation to computation

REFERENCES:

1. Peter Eisenmann, Diagram: An Original Scene of Writing, Diagram Diaries
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	Understandingoftheeffectofcontemporarytheoriesofmediaoncontemporaryarchitecturaldesign.												
CO2	Understandingofvariouscontemporarydesignprocessandtheirrelationtocomputation												
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 relation 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	6 th Meeting of Academic Council											

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 and identity.
- 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 in India.

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 role in 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**

Listing of monuments – documentation of historic structures – assessing architectural 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 site management.

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**OUTCOMES:**

- The students would gain an understanding of the need and benefits of urban conservation.
- The students would be sensitised as well as informed to carry forth this understanding in the realm of practice/research

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 University 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, Bernard Fielden
5. Bernard Feilden, Conservation of Historic Buildings, 2nd Edition, Butterworth, 1994.
6. B.K. Singh, State and Culture, Oxford, New Delhi.
7. A.G.K. Memon ed. Conservation of Immovable Sites, INTACH Publication, N. Delhi Seminar Issue on Urban Conservation.
8. Christopher Brereton, The repair of Historic Buildings. Advice on principles and methods; English Heritage 1991.

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 and identity.												
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.												
CO6	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
	CO6			M			L						
3	Category	Professional Core (PC)											
4	Approval	5 th Meeting of Academic Council											

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 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 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 Generalife, Granada.

UNIT II RENAISSANCE 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 15

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. Olmstead, 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 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

- Relationship between culture and Landscapedesign.
- Perception of open spaces in differentcultures.

1. Geoffrey and Susan Jellicoe, *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 Nostrand publishers, 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*, Skira Editores P.A. 2003.

COURSE OUTCOMES (COs)													
The student will be able													
CO1	Relationship between culture and Landscape design.												
CO2	Perception of open spaces in differentcultures.												
CO3	To study the social and cultural influences on traditional landscapes through analysis of form and space, siting principles of each period withexamples.												
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	4 th Meeting of Academic Council											

OBJECTIVES:

- To sensitize the students to the various aspects of sustainable and green building design in the context of global warming and climate change
- To study the building material for its impact on environment.
- To expose the students to green rated buildings.

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 friendly design.

UNIT II ECOHOUSE 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 and analysis.

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 of buildings.

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

OUTCOMES:

- An understanding on sustainability
- Knowledge on renewable energy and energy conservation through material usage.
- A thorough understanding on designing green buildings.

REFERENCES:

1. Ken Yeang; Eco design - A Manual for Ecological design, Wiley- Academy; 2006
2. Sue Roaf et al; 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.
CO6	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
	CO6			M			M						

3	Category	Professional Core (PC)
4	Approval	3 rd Meeting of Academic Council

COURSE OUTCOMES (COs)

The student will be able

[illegible]

OBJECTIVES:

- To provide an overview of various contemporary architects in terms of their works, design philosophies and processes.
- 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 and space

UNIT II MEDIA AND ARCHITECTURE 9

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

UNIT III ISSUES 9

Towards new paradigm – A myth or a promise. / Need versus desire/ anxiety of new/ identity and Fashion.

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

OUTCOMES:

- The student will learn about various design methodologies employed by contemporary architects.
- The student will be acquainted with the use of computation and digital technologies in contemporary architectural design.
- The student will learn to investigate the influence of various media, especially films, on architecture and viceversa.

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

[illegible]

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 within buildings

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 with ECOTECT

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

OUTCOMES:

- The students will gain knowledge on environmental assessment methods, audit and simulation techniques.
- Will add value to architectural design processes and equip students with energy modeling skills.

REFERENCES:

1. Energy Audit of Building Systems – Moneef Krarti (Ph.D) – CRC Press 2000
2. Clarke, J.A., “Energy simulation in building design”, Adam Hilger Ltd, Bristol, 1985
3. ESRU, “ESP-r A Building Energy Simulation Environment; User Guide Version 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 (in Czech).

COURSE OUTCOMES (COs)	

The student will be able

CO1	Knowledge on environmental assessment methods, audit and simulation techniques.
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
CO6	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
	CO6						M					H	

3	Category	Professional Ability Enhancement Courses (PAEC)
4	Approval	5 th Meeting of Academic Council

OBJECTIVES:

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

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 Architecture and 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 collection systems and recycling of water- solid waste disposal . “Some latest Trends Observation, NBC’s recommendations. in these areas can be included.

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- Lobby design- 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**OUTCOME**

- Students can apply some or all of these services in one of their design projects.

REFERENCES:

1. William J. McGinness, 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. A K Mittal, Electrical and Mechanical Services in High Rise Buildings Design and Estimation Manual, 2001
4. Yahya Mohamad Yatim, 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, 2003

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
CO6	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	4 th Meeting of Academic Council											

- To understand in depth the increasing complexity of buildings today with respect to technology, services and planning.
- To design within this context.

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.

- Students would be made aware of the emerging technical areas of architecture.
- Students would get an understanding of designing optimally, balancing the basics of architectural design with emerging new technical and planning parameters.

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												
CO6	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
	CO6					M	L					M	
3	Category	Professional Core (PC)											
4	Approval	4 th Meeting of Academic Council											

OBJECTIVE:

- This course will examine the redefinition of contemporary housing within the context 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**OUTCOME:**

- The students will understand the latest development, issues and design strategies governing the Housing in National and international level.

REFERENCES:

1. Manuel Gausa and Jaime Salazar; 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.

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 evolutionof modern housing
CO5	Evaluate the development in various countries
CO6	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	32 nd Meeting of Academic Council											

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 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 Methodology- 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

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
CO6	Cyber security and laws related to the same. Plagiarism in research: Introduction to the concept, Problem of plagiarism & software to check the same

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

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

Table 2: Indicators (Strength of Connectivity) - High, M: Medium, L: Low													
	CO1	H	H	M		M			M	H	H		H
	CO2		L			L			M				H
	CO3		L			L			M				H
	CO4									M		M	H
	CO5		M	M	M				M		H		
	CO6				M				L				
3	Catego ry	Professional Core(PC)											
4	Approva l	32 nd Meeting of Academic Council											

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, theory, 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**OUTCOMES:**

- A Dissertation book which is based on accepted norms of technical writing.
- An understanding leading to formation of thesis ideas.

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 Methodology- 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.

The student will be able

(H/M/L indicates strength of 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	32 nd Meeting of Academic Council											

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

OUTCOMES:

- Students would be aware of contemporary processes and tools of design.
- Students would use these processes and tools in the design projects to identify and address specific aspects of the project, as well as integrate complexity of connections and issues.

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
CO6	To resolve complex landscape issues in urban and rural fabric with landscape design and Planning & To be able to derive an open space

Mapping of Course Outcomes with Program Outcomes (POs)

(H/M/L indicates strength of 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	32 nd Meeting of Academic Council											

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 model and plotting.

UNIT II ADVANCED MODELING – FAMILY TYPES AND TOPO SURFACE 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

- This is a project-based course where students gain knowledge on the implementation of BIM concepts throughout the lifecycle of a building, from planning and design, to construction and operations.
- The students will learn about how to use BIMs for building energy performance simulation, construction administration

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. NewYork: Wiley.
2. Ray Crotty;(2011) The Impact of Building Information Modelling: Transforming Construction. Spons Architecture PriceBook.

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.												
CO6	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	32 nd Meeting of Academic Council											

- 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.

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.

OUTCOMES:

- Students would be able to integrate various contemporary/ advanced issues and techniques into the architectural design process.
- Students would be able to identify and go in depth into specific and appropriate aspects relating to the discipline of architecture and reflect this in the realm of design.

The student will be able

CO1	To use all the skills acquired in the duration of preceding academic courses.
CO2	Methodically self-direct effort by choosing the project of choice, builds capacity to work independently and methodically in a variety of intellectually and professionally demanding contexts.
CO3	Learn to make an original and individual, creative contribution to the academic discipline and/or the professional field in some cases.
CO4	Be able to interpret the urban forms of the past and present.
CO5	Articulate their stance and position as a designer within discourses of urbanism.
CO6	Research and analyse information relevant to developing the proposal

(H/M/L indicates strength of 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	
	CO6				M				L				

3	Category	Professional Core(PC)
4	Approval	32 nd Meeting of Academic Council

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 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 Address System, various types of technologies currently in use and design guidelines to be followed and basic knowledge 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 AND 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 AND 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

OUTCOME:

- To ensure that every architect understands & designs the buildings that facilitates safe, code compliant, secure & comfortable buildings for the occupants.

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 & PeterTurnbull
3. Rules for Automatic sprinkler Installation – second edition – Pub: Tariff AdvisoryCommittee.
4. CCTV Surveillance, HermanKruegle.
5. National Building Code of India 2005 (PartIV)
6. Bureau of Indian Standards IS2189, IS2190, IS15105,IS13039.
7. Fire Suppression Detection System, John L.Bryan.
8. Security Systems and Intruder Alarm System, VivianCapel.

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	14 TH Meeting of Academic Council											

**GMA002 APPROPRIATE TECHNOLOGIES AND SUSTAINABLE
CONSTRUCTION**

**L T P/S C
3 0 03**

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

OUTCOMES:

- An understanding on the needs of alternative technologies in buildings.
- An exposure to sustainable materials and construction.

REFERENCES:

1. Brenda and Robert Vale; Green Architecture: Design for a sustainable future; Thames and Hudson; 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	10 TH Meeting of Academic Council											

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 overview 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 spaces- aesthetisation of architectural issues- influence of globalisation and digital revolution on architectural processes- debates of heritage- gender and space.

TOTAL: 45 PERIODS**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.

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
CO6	To understand the architectural issues and architectural processes.

(H/M/L indicates strength of 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	PE(PROFESSIONAL ELECTIVE)											
4	Approval	04TH Meeting of Academic Council											

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**OUTCOMES:**

- The student will increase the knowledge on GIS and the various characteristics of Data.
- The student will accept the potential of GIS and develop integrated practice of using the GIS application with architecture.

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

C O1	To introduce the principles of aerial and satellite based remote sensing for studying earth resources.
C O2	To introduce geophysical well logging techniques for interpretation of subsurface geology
C O3	well logging, classification of well logging methods, formation evaluation and its importance.
C O4	Basic principles, SP log, normal and lateral logs, focused logs, micro resistivity tools and their role in formation evaluation; Applications.
C O5	Basic principles of different types of radiation logs including gamma ray, gamma-gamma, neutron thermal and chlorine logs; Porosity determination and cross plots; Applications
C O6	Permeability, bound and free-water estimation using NMR logging techniques; Applications Caliper, dip meter, cement bond logging, casing collar locators, temperature logging.

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

a	b	c	d	e	f	g	h	i	j	k	l

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	PE(PROFESSIONAL ELECTIVE)											
4	Approval	10TH Meeting of Academic Council											

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. Norberg 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

- A comprehensive understanding of architecture and urbanism as expressions of particular societies in time and place.

1. Roxanna Wasterson; The living House Anthropology of Architecture in S E Asia; Oxford Press.
2. Claire Melhuish (ed); Architecture and Anthropology – AD Vol 66 No 11/12 Nov -1996
3. Joseph Rykwert; On Adams house in Paradise; MIT Press1987
4. O F Bollnow; Mann, Bensch and Raum, Stuttgart;1963.
5. Joseph Rykwert – Idea of a Town: The Anthropology of Urban Form in Rome;1976.
6. Nold Egenter; The review of the Primitive in Architecture – Architectural Anthropology – Research Series Vol. I and II; Structura Mundi; 1992 and1996.
7. Edwin James; Anthropology of the City; Prentice Hall;1977.
8. J Carstern and S H Jones; About the house: Levi Strauss and Beyond; Cambrige University Press;1955.

The student will be able

C O1	A comprehensive understanding of architecture and urbanism as expressions of particular societies in time and place.
C O2	To understand the relationship between society and the making of the built environment.
C O3	To understand phenomenology and the role of meaning in built form.
C O4	To look at place making from the architectural as well as urban design point of view
C O5	perceptions of built form – conceptions of space
C O6	role of cities – urban ethnography, primary units, major components

(H/M/L indicates strength of 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					
	C06												
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	10TH Meeting of Academic Council											

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, CHARACTERISTICS 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, CHARACTERISTICS 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

OUTCOMES:

- A holistic understanding of the physical processes of building, including gaining knowledge about historical, material and cultural aspects.
- Gaining sensitivity and knowledge with respect to process of physical interventions in historic buildings.

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 Adaptive Reuse; Applications for Architects and Engineers; Wiley 2000
4. Kirk Urwin J.; Historic Preservation Handbook; McGraw Hill 2003
5. Ernest Burden; Illustrated Dictionary of Architectural Preservation; McGraw Hill 2003

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 revolutionary, 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	13 TH Meeting of Academic Council											

- 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.

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.

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.

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

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.

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

- Basics of Ecology and LandscapeEcology.
- Landscape planning history, evolution, process and casestudies.

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.

COURSE OUTCOMES (COs)													
The student will be able													
CO1	Understand the Basics 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	09 TH Meeting of Academic Council											

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

OUTCOMES:

- Understanding of sustainability from macro to microlevel.
- Knowledge on Energy conscious Landscapedesign

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 EnergyConservation,
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, NewDelhi
5. Grady Clay, Water and the landscape McGraw-Hill Inc.,US; First Edition edition1979)

COURSE OUTCOMES (COs)													
The student will be able													
CO1	Knowledge to make aware of the Sustainable design aspects for landscape and Green buildings designconcepts.												
CO2	Analyze the sustainable development in relation to natural resourceconservation energy conservation, environmental pollution and conservation ofbio-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											

OBJECTIVE:

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

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.

UNITII URBAN SPACES**9**

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

UNITIII 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.

UNITIV ELEMENTS INURBANLANDSCAPE**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,

UNITV CASESTUDIES**9**

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

TOTAL: 45 PERIODS**OUTCOMES:**

- Types, characteristics and elements of urban openspaces.
- Case studies of urbanlandscapes.

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 ReinholdCompany.
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, Eand 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 openspaces.												
CO2	Analyse the Case studies of urbanlandscapes.												
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	AnalyseUrban 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	2 ND Meeting of Academic Council											

UNIT I INTRODUCTION TO WEB DESIGN

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 IMAGE READY. 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 IMAGE READY, 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, Deke McClelland, 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.
CO6	To implement with the web design and to prepare a model in software

Mapping of Course Outcomes with Program Outcomes (POs)	
Course Outcomes CO1: Understand the basic concepts of the course. CO2: Apply the concepts to solve problems. CO3: Analyze the system and design a solution. CO4: Evaluate the performance of the system.	Program Outcomes (POs) PO1: Graduate should have the ability to apply knowledge of mathematics, science, and engineering. PO2: Graduate should have the ability to design and conduct experiments, analyze and interpret data. PO3: Graduate should have the ability to design a system, component, or process to meet specified requirements. PO4: Graduate should have the ability to identify, formulate, and solve complex engineering problems. PO5: Graduate should have the ability to use modern engineering tools and techniques. PO6: Graduate should have the ability to communicate effectively in written and oral form. PO7: Graduate should have the ability to work in a team. PO8: Graduate should have the ability to manage projects. PO9: Graduate should have the ability to understand the impact of the engineering solutions in the context of the society and the environment. PO10: Graduate should have the ability to engage in lifelong learning.

(H/M/L indicates strength of 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	6 th Meeting of Academic Council											

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH – INDUSTRIAL BIO TECHNOLOGY – FULL TIME
SEMESTERS I - IV

SEMESTER I						
SUB. CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
MBT101	PC	Principles of Process Engineering	3	0	0	3
MBT102	PC	Advanced Biochemistry	3	0	0	3
MBT103	PC	Industrial Microbiology and Fermentation Technology	3	0	0	3
MBT104	PC	Plant and Animal Biotechnology	3	0	0	3
MBT105	PC	Enzyme Engineering	3	0	0	3
MBT1E1	PE	Professional Elective I	3	0	0	3
PRACTICAL						
MBT1L1	PC	Plant and Animal Biotechnology Lab	0	0	6	2
MBT1S1	PR	Technical Seminar-I	0	0	2	1
TOTAL HOURS: 26			CREDITS: 21			

SEMESTER II						
SUB. CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
MBT201	PC	Immunotechnology	3	0	0	3
MBT202	PC	Recombinant DNA technology	3	0	0	3
MBT203	PC	Bioprocess Engineering and Plant Design	3	0	0	3
MBT204	PC	Stem cell and Tissue Engineering	3	0	0	3
MBT205	PC	Downstream Processing	3	0	0	3
MBT2E2	PE	Professional Elective II	3	0	0	3
PRACTICAL						
MBT2L1	PC	Bioprocess engineering and downstream processing Lab	0	0	6	2
MBT2S1	PR	Technical Seminar-II	0	0	2	1
TOTAL HOURS: 26			CREDITS: 21			

SEMESTER III						
SUB. CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
MBT3E3	PE	Professional Elective III	3	0	0	3
MBT3E4	PE	Professional Elective IV	3	0	0	3
MBT3E5	OE	Open Elective	3	0	0	3
PRACTICAL						
MBT3P1	PR	Project phase I	0	0	12	6
MBT3V1	PR	In-plant Training Note: Students to get trained in an industry for a period of two weeks at the end of II semester)	0	0	0	1
TOTAL HOURS: 21			CREDITS: 16			

SEMESTER IV						
SUB. CODE	CATEGORY	COURSE TITLE	L	T	P	C
MBT4P1	PR	Project phase II	0	0	35	12
TOTAL HOURS: 35			CREDITS: 12			
OVERALL CREDITS FOR THE PROGRAMME : 70						

LIST OF ELECTIVE SUBJECTS

PROFESSIONAL ELECTIVE (PE) I

MBTE01	Biopharmaceutical Technology	3	0	0	3
MBTE02	Food Process Engineering	3	0	0	3
MBTE03	Medical Biotechnology	3	0	0	3
MBTE04	Waste Management Technology	3	0	0	3

PROFESSIONAL ELECTIVE (PE) II

MBTE05	Developmental Biology	3	0	0	3
MBTE06	Dairy Technology	3	0	0	3
MBTE07	Cancer biology	3	0	0	3
MBTE08	Biofuel Technology	3	0	0	3

PROFESSIONAL ELECTIVE (PE) III

MBTE09	Metabolic Engineering	3	0	0	3
MBTE10	Food industry waste management	3	0	0	3
MBTE11	Nanobiotechnology	3	0	0	3
MBTE12	Alternate energy	3	0	0	3

PROFESSIONAL ELECTIVE (PE) IV

MBTE13	Proteogenomics and Bioinformatics	3	0	0	3
MBTE14	Food safety and quality control	3	0	0	3
MBTE15	Biosensor Technology	3	0	0	3
MBTE16	Industrial Safety Engineering	3	0	0	3

OPEN ELECTIVE (OE)

MMA01	Biostatistics	3	0	0	3
MBTE17	Bio entrepreneurship development	3	0	0	3
MBTE18	Research Methodology for Bioengineering	3	0	0	3

MBT101		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I 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 II ENERGY 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.

UNIT III AGITATION 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 IV HEAT 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 Overall heat transfer coefficient - LMTD. Evaporator- Types: falling film- Climbing film- Forced circulation and Agitated film evaporator- Methods of feeding.

UNIT V MASS TRANSFER**9**

Diffusion: Outline of Mass transfer operations- Diffusion in Gases, Liquids and Solids. Distillation: Theory of Simple, Flash, Steam and Azeotropic distillation- McCabe Thiele 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" Nirali Prakasham Publications 25th Ed.

REFERENCE BOOKS:

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

MBT102	ADVANCED BIOCHEMISTRY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: General biochemistry				
	Course Designed by : Dept 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, structure 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	37 th , 38 th & 39 th 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 blocks 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

MBT103		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 caused by 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	37 th , 38 th & 39 th 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, Archaea 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 PRIMARY METABOLITES**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 metabolites-antibiotics-beta lactams (penicillin-cephalosporin)-Aminoglycosides (streptomycin, kanamycin)-Macrolides (erythromycin)-Vitamins, Production of Vaccines and Recombinant Proteins-Proteases, Amylases, Lipases.

UNIT VI INDUSTRIAL APPLICATIONS**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. Peleazar, J.R.E.C.S Chan, Noel R. Erieg, 2005, "Microbiology "TATA McGraw Hill, 5th Ed.

REFERENCE BOOKS:

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

MBT104	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	37 th , 38 th & 39 th 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 II PLANT 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 III TRANSGENIC 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 IV ANIMAL 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 V TRANSGENIC 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. Sudha Gangal , 2002, "Principles and Practice of Animal tissue culture", IV Ed
3. P. Ramadass , 2008, " Animal Biotechnology" MJP pub

MBT105	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

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-Michaelis Menten 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 IV TRANSPORT PHENOMENA

9

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 V BIOREACTORS

9

Bioreactors: Classification, Batch and continuous types, High performance bioreactors, Sterile

MBT1L1		PLANT AND ANIMAL BIOTECHNOLOGY LAB			L	T	P	C
		Total Contact Hours: 60			0	0	6	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	37 th , 38 th & 39 th 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 <i>Daucus carota</i>. 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 <i>Aloe vera</i> 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.	12. Isolation of plant genomic DNA from leaf sample. 13. Agarose gel electrophoresis of the DNA sample. 14. Aseptic techniques for animal cell culture. 15. Establishment of a primary culture. 16. Resuscitation of frozen cell lines. 17. Subculture of adherent cell lines. 18. Subculture of semi-adherent cell lines. 19. Subculture of suspension cell lines. 20. Cell quantification. 21. Cryopreservation of cell lines. 22. Isolation of bacteriophage particles.

MBT1S1	TECHNICAL SEMINAR I	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – General Biochemistry, General Microbiology, Cell Biology				
	Course Designed by– Dept. of Industrial Biotechnology				
OBJECTIVES To enable students to create the habit of exploring new avenues of biotechnology and to improve their presentation skills					
COURSE OUTCOMES (COs)					

- It is a one credit course offered in the I Semester
- Each student will be allocated topics for presentation
- There are 2 hours allocated per week for the students to give their presentation. This will be considered for the award of internal marks.
- The final topic will be presented on the day of the external examination in the presence of the 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

MBT201		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	37 th , 38 th & 39 th 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, - Antigens – antigenicity, 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 III ANTIGEN-ANTIBODY INTERACTIONS

9

Immune techniques- antigen-antibody reactions, cross reactivity, precipitation reactions, agglutination reactions, RIA, ELISA, Immuno-precipitation, Immuno-fluorescence, 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 V HYPERSENSITIVITY

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, 3rd ed.
2. Abbas, 2009, “Basic Immunology” W.B. Saunders company, 2nd ed.

MBT202		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 and growth in real life situations						
CO3		to get the knowledge of molecular scissors and its role in creating transgenic products						
CO4		to know the techniques related to screen the recombinant products						
CO5		to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
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	37 th , 38 th & 39 th 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-topoisomerase-Polynucleotide kinase-Exonuclease III-DNase I-DNA polymerase and Klenow fragment- Terminal nucleotidyl transferase- RNA dependent DNA polymerase

UNIT II VECTORS/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 IV APPLICATIONS 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.

MBT203	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I BIOPROCESS 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 coefficient.

UNIT II KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

9

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 III PROCESS 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.

MBT204		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April						

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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 NEURO CULTURE

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. Sudha Gangal, 2002, "Principles and Practice of Animal tissue culture", IV Ed
2. P. Ramadass, 2008, "Animal Biotechnology" MJP pub

MBT205	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

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 SEPARATION TECHNIQUES

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 III EXTRACTION 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 – Chromatofocusing – 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).

MBT2L1		BIOPROCESS ENGINEERING AND DOWNSTREAM PROCESSING LAB				L	T	P	C
		Total Contact Hours: 45				0	0	6	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 purification techniques							
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)
		√			
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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 <i>E.coli</i>. 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) 18. Solids Recovery by Centrifugation 19. Paper chromatography 20. Thin Layer Chromatography 21. Ion –Exchange Chromatography 22. Affinity Chromatography 23. Gel Filtration 24. Sonication 25. Crystallization 26. Aqueous Two Phase Extraction Of Proteins 27. Enzyme Purification by Salt precipitation Method

MBT2S1	TECHNICAL SEMINAR II	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – General Biochemistry, General Microbiology, Cell Biology				
	Course Designed by– Dept. of Industrial Biotechnology				

OBJECTIVES

To enable students to create the habit of exploring new avenues of biotechnology and to improve their presentation skills

COURSE OUTCOMES (COs)

- It is a one credit course offered in the II Semester
- Each student will be allocated topics for presentation
- There are 2 hours allocated per week for the students to give their presentation. This will be considered for the award of internal marks.
- The final topic will be presented on the day of the external examination in the presence of the 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

MBT3P1	PROJECT PHASE I	L	T	P	C
	Total Contact Hours -60	0	0	12	6
	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

MBT4P1	PROJECT PHASE II			L	T	P	C
	Total Contact Hours -35 hrs per week			0	0	35	12
	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

ELECTIVES

MBTE01	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 pharmaceuticals 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Introduction to biopharmaceuticals – 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

Bioprecursor prodrugs – 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. Brahmkar Sunil B.Jaiswal, 2008, “Biopharmaceutics and Pharmacokinetics” Vallabh Prakashan, 1st Ed.

REFERENCE BOOKS:

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

MBTE02		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	37 th , 38 th & 39 th 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 II FOOD 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 IV FOOD 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 V GRAIN STORAGE

9

Storage types-disinfestation of grains-controlled atmosphere storage-useful of CO₂ 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.

- Hamm & Hammlton, 2000, "Edible oil processing" Academic Press 5th Ed.
- Fellows, 2009, "Food processing technology" 21th Ed.
- Heldman, 2007, "Hand book of food engineering" CRC Press 2nd Ed.
- P.G. Smith, 2003, "Food Process Engineering" Academic Plenum Pub, New York 1st Ed.

MBTE03		MEDICAL BIOTECHNOLOGY			L	T	P	C
		Total Contact Hours – 45			3	0	0	3
		Prerequisite – Immunology, physiology, animal biotechnology						
		Course Designed by – Dept of Industrial Biotechnology						
OBJECTIVES To provide a basic understanding of biological systems and their applications								
COURSE OUTCOMES (COs)								
CO1	to understand the fundamentals of genetics and their relationship to hereditary disorders							
CO2	to apply the concept of plant, animal and microbial systems in discovery of medicine							
CO3	to comprehend genetics and the immune system							
CO4	to know the cause, symptoms, diagnosis and treatment of common diseases							
CO5	to know the cause, symptoms, diagnosis and treatment of common diseases							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I HUMAN GENETICS

9

Genes and Chromosome- structure, function and inheritance- Repetitive DNA in human genome- Alu, LINE and SINE repeats- Congenital abnormalities, Clinical aspects of autosomal and sex

chromosomal disorders. Gene therapy and its types

UNIT II HUMAN PHYSIOLOGY 9

Structure, types and functions of tissues and muscles-Biological functions and abnormalities of digestive system, circulatory system, excretory system and central nervous system

UNIT III HORMONES 9

Hormones- structure, classification, biosynthesis and circulation in blood- Synthesis transport and biological functions of pituitary hormones, thyroid hormones and pancreatic hormones

UNIT IV CLINICAL BIOCHEMISTRY 9

Blood sugar level in diabetes mellitus- Blood pressure and cholesterol level in heart attack- Clinical significance of diagnostic enzymology- Evaluation of renal, pancreatic, liver and intestinal function

UNIT V GERM LINE ENGINEERING 9

Characteristics and diagnostic applications of stem cell culture, organ culture, embryo culture – Artificial blood- Genetic counseling-Artificial insemination, IVF and embryo transfer in humans- Egg and sperm Preservation banks

TEXT BOOKS

1. Lehninger Nelson & Cox., 2009 “Principles of Biochemistry”, 5th edition
2. Chatterjee and Raneshinde 2009 “Clinical Biochemistry” 7th edition.

REFERENCES

1. Guyton, 2010 “Medical physiology”, 12th edition
2. Devlin, 2005 “Biochemistry with clinical correlation”, 10th edition
3. Weblink: nptel

MBTE04	WASTE MANAGEMENT TECHNOLOGY		L	T	P	C
	Total Contact Hours – 45		3	0	0	3
	Prerequisite – Environmental Science					
	Course Designed by – Dept of Industrial Biotechnology					
OBJECTIVES: To give a basic knowledge of waste handling and its management						
COURSE OUTCOMES (COs)						
CO1	to understand the various types of waste					
CO2	to know the technology to handle the waste material					
CO3	to know about waste disposal methods					
CO4	to know the remedial measures for waste disposal					
CO5	to know about applications of waste management 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	
	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Introduction: Definition and Classification- Disposal methods: Land fill and Incineration – Recycling methods: biological reprocessing and Energy recovery-. Avoidance and Reduction Methods- Waste handling and Transport – Waste management Concepts

UNIT II AGRICULTURAL WASTE

9

Introduction- Waste Consistency- Waste Management Function: Production ,Collection, Storage, Treatment , Transfer, Utilization- Waste Management system Design – Waste Management System: Dairy Waste, Beef Waste, Swine Waste, Poultry Waste, Other animal – Municipal and Industrial Sludge- Food Processing – Agri Chemical Waste Management- Handling.

UNIT III BIOMEDICAL WASTE

9

Introduction- Overview – Characterization of Medical Waste- Waste Generation Methodology – Sterilization- Chemical Disinfection – Thermal Inactivation- Irradiation- Microwave Treatment – Grinding and Shredding – Compaction- Current Practice – Standards .

UNIT IV INDUSTRIAL WASTE MANAGEMENT

9

Paper and Pulp Industry – Leather Industry – Cement Industry – Chemical Industry – fertilizer Industry – Pharmaceutical Industry – Textile industry – Iron and Steel industry – Mining Industry – Lignite industry – Petroleum Industry – Nuclear Industry.

UNIT V REMEDIAL MEASURES

9

Bioremediation – Phyto-remediation- Recycling of Plastic and Paper

TEXT BOOK:

1. Agricultural Waste Management Hand Book by USDA, III Ed,2005

REFERENCE BOOKS

1. Industrial Biotechnology Problems and Remedies by Indu Shekhar Thakur, VI Ed, 2006
2. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

MBTE05	DEVELOPMENTAL BIOLOGY					L	T	P	C
	Total Contact Hours - 45					3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology								
	Course Designed by – Dept of Industrial Biotechnology								
OBJECTIVES: To provide basic knowledge about biology of human system									
COURSE OUTCOMES (COs)									
CO1	to understand the history and scope of developmental biology								
CO2	to know about fertilization								
CO3	to know basic concepts on cleavage								
CO4	to know about regeneration								
CO5	to study the various processes involved in regeneration								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Developmental biology: its scope, history and special fields-Germ cells: origin of germ cells, its

migration and fate-Spermatogenesis: cells in seminiferous tubes, spermiotolosis, nuclear control of spermiotolosis, ultramicroscopic structure of mammalian sperm, types of sperm.

UNIT II OOGENESIS

9

Oogenesis: growth of oocyte, maturation of ovum, formation of yolk, accessory cells, egg cortex and its importance, egg membrane-Fertilization: significance of sperm-egg interaction, acrosome reaction, sperm penetration, behaviour of pronuclei, syngamy, polyspermy, activation of egg-Parthenogenesis: natural and artificial.

UNIT III CLEAVAGE

9

Cleavage: definition, early history and concept, geometry of cleavage, types of cleavage, cleavage patterns and factors governing them, laws of cleavage, theories of cytokinesis-Gastrulation: morphogenetic movements, selective affinity and adhesiveness of cells, mechanism of the change of shape of cell during morphogenesis-Embryonic induction: Spemann's primary organizer, nature of induction mechanism of action of inducing substances.

UNIT IV EMBRYO DEVELOPMENT

9

Organization of the early embryo: polarity, symmetry, regulative development and physiological gradients, mosaic development- Differentiation: equivalence of nuclei, cytoplasmic control of nuclear activity, genetic control of differentiation, isozymes, mass effects-Metamorphosis: insect metamorphosis, amphibian metamorphosis, metamorphosis and evolution.

UNIT V REGENERATION OF TISSUES AND ORGANS

9

Regeneration: regeneration in amphibians and planarian, stimulation and suppression of regeneration, histological processes concerned in regeneration, gradient concept, neural and endocrine influences- Developmental aspects of immunology- Teratology: factors inducing abnormal development of tissues and organs.

TEXT BOOK

1. B. Balinsky 2004, "An introduction to embryology", 5th ed.

REFERENCES

1. J. Brachet, 2003, "Introduction to molecular embryology".
2. N.J. Berrill, 2005, "Developmental biology".
3. Gene activity in early development, (2005), H. Davidson.
4. Weblink: nptel

MBTE06	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

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 II DAIRY PRODUCTS

9

Fat rich Dairy products – Cream, preparation, types, defects – Butter preparation, types, defects – Butter Spreads- Preparation of Ghee , defects in ghee- AGMARG standards- Frozen dairy products – Manufacture of Ice Cream: Ingredients and their role, types and defects, Judging and grading of Cream, Butter and Ice Cream. Concentrated and dried milk Products- Condensed milk – Evaporated milk – BIS standards –defects- Manufacture of milk powder- whole milk, skim milk powder- spray drying – whey powder- whey protein concentrates- biodiesel from whey.

UNIT III CHEESE AND FERMENTED PRODUCTS

9

Cheese and fermented products- Classification- preparation of cheddar, cottage, 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- Gulab jamun – Rasagolla – preparation of paneer – kulfi – utilization of skim milk – butter milk – whey.

UNIT V QUALITY 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

MBTE07	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	37 th , 38 th & 39 th 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 III ONCOGENES

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, Prostate, 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

MBTE08		BIOFUEL TECHNOLOGY				L	T	P	C
		Total Contact Hours - 45				3	0	0	3
		Prerequisite – Basic Biotechnology, Bioprocess							
		Course Designed by – Dept of Industrial Biotechnology							
OBJECTIVES: To provide a basic understanding of fuel and biofuel concepts and its production techniques									
COURSE OUTCOMES (COs)									
CO1		to understand the fundamentals of biofuel							
CO2		to know the various source for biofuel							
CO3		to apply the technique in large scale							
CO4		to study about lipid derived biofuel							
CO5		to give a basic knowledge of the applications biofuel							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Introduction – Potential of biomass – biofuel policies: Policy in EU – Biofuel standardization – International Trade of biofuel-Biofuel Life Cycle – Energy balance -& Efficiency of biofuel – Biofuel emission: Greenhouse gas emission – Vehicle emission standards – other environmental Impacts of Biofuel – economy of biofuel – Consideration of Co-Products.

UNIT II BIOETHANOL

9

BioEthanol – Feed stock production: sugar Crops, Starch crops , Cellulosic feed stock – Bioethanol Production : Sugar to ethanol Process, Starch to ethanol process, Cellulose to Ethanol Process – Distillation & Dehydration process – Properties – Application –standardization – Energy balance – Bioethanol Emission : Greenhouse gas emission, toxic exhaust emission – Other environmental impacts: water issues, land use & biodiversity, human Health.

UNIT III LIPID BIOFUELS**9**

Lipid derived Biofuel – Feed stock production -: Oil seed crops, Micro algae , Animal fats, waste oils – Fuel production : Oil Extraction , Oil Refining, Transesterification – Properties & Use : Properties of Pure Plant Oil (PPO) , Properties of Biodiesel – Application – Energy balance – Emissions of lipid biofuel – Other Environmental Impacts – Economy.

UNITIV BtL FUELS**9**

BtL Fuel: Feed Stock production – BtL production – Gasification, Gas Cleaning – Synthesis process-Biohydrogen: Processing – Use – The Future of Biofuel.

UNIT V BIOMETHANE**9**

Biomethane – Feed stock Production- BioMethane Production : Digestion Process- Digester types- biogas Purification – Properties & Use – Application – Standardization – BioMethane Emission – Other Environmental Effects – Economy.

TEXT BOOK

1. Dominik Rutz& Rainer Janssen, 2007, “Hand Book on BioFuel Technology”, II ED.

REFERENCE BOOKS

1. SoetaertErlckI. Vandamme, 2009, “Biofuels” John Wiley & Sons, 1st.ed.
2. Hand Book on “ BioFuel Technology” by Dominik Rutz& Rainer Janssen, 2007
3. “Bioprocess technology” – P.T. Kalaichelvan and I. Arul Pandi. 2007. MJP Pub.
4. CayeDrapcho, John Nghiem, Terry Warker, 2007, “Biofuel Engg& Process Technology” Mc-Graw Hill, 1st.ed.

MBTE09	METABOLIC ENGINEERING				L	T	P	C
	Total Contact Hours - 45				3	0	0	3
	Prerequisite – Biochemistry, Microbiology							
	Course Designed by – Dept of Industrial Biotechnology							
OBJECTIVES: To give a knowledge of metabolism								
COURSE OUTCOMES (COs)								
CO1	to understand stoichiometry of growth							
CO2	to know about electron balance calculations							
CO3	to know about metabolic energy changes.							
CO4	to know about thermodynamic efficiency							
CO5	to know about applications of kinetics of chemical reactions							
Mapping of Course Outcomes with 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Energetics of metabolism, energy coupling (TP and NADH), Stoichiometry of cell growth and product formation, Elemental Balances, Degree of Reduction fundamental concepts, Yield coefficients, oxygen consumption and heat evolution in aerobic cultures

UNIT II STOICHIOMETRY

9

Metabolic stoichiometry, Energetics of Batch and continuous process, Stoichiometry of cell growth and product formation, degrees of reduction of substrate and Biomass-Available electron Balances, yield coefficients of biomass and product formation, Maintenance coefficients Energetics analysis of microbial growth and product formation, oxygen consumption and Heat evolution in aerobic and anaerobic cultures.

UNIT III GROWTH AND METABOLISM

9

Thermodynamic efficiency of growth, Thermodynamics and kinetics of cell metabolism Metabolic pathways, modeling of Embden Meyers Parnas pathway. Thermal and Energetic studies, Activation Energies of reaction and Heat of reaction, formation and combustion of biochemical reactions

UNIT IV METABOLIC PATHWAYS

9

Thermodynamic efficiency of glucose catabolic pathways as EMP pathway, TCA cycle, urea cycle, AMP cycle, Analysis of anabolic pathways for synthesis of Metabolites and carbon molecules build, thermodynamic efficiency, Photosynthesis Type I and Type II processes, Thermodynamic and kinetic analysis and Mechanism.

UNIT V SIGNAL TRANSDUCTION

9

Signal transduction –receptors and methods of action –signal amplification and different models, G proteins-phosphatidyl and inositol- cAMP-calcium ions-protein kinase-defects in signaling pathways.

TEXT BOOKS

1. Robertson & Noel, 2004, “Protein Engineering” Elsevier academic press.

- Dugas. H, Bio-Organic Chemistry - A chemical approach to enzyme action, Springer Verlag, 2002, revised edition

REFERENCE BOOKS:

- Cleland & Craik, 1996, "Protein Engineering Principles & Practice" Wiley-Liss.
- Voet & Voet, 2006, "Biochemistry" V Ed,
- Lehninger Nelson & Cox, 2005 "Principles of Biochemistry", 4th Ed

MBTE10		FOOD INDUSTRY WASTE MANAGEMENT				L	T	P	C
		Total Contact Hours - 45				3	0	0	3
		Prerequisite – Food processing							
		Course Designed by – Dept of Industrial Biotechnology							
OBJECTIVES: To provide basic knowledge about waste generated from food industries and their utilization									
COURSE OUTCOMES (COs)									
CO1		to know about the types of food industry waste							
CO2		to know about food industry effluents							
CO3		to know about the types of byproducts from food industries							
CO4		to get ideas about the utilization of waste							
CO5		to learn about value added products from food 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	M				
	CO2	H	H		L	M			
	CO3	H	M	M		M			
	CO4	M		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Sources of food industry waste- nature of different waste-status in India-Basic considerations: Standards for emission or discharge of environmental pollutants from food processing Industries as per the updated provision of Environment (Protection) Act, 1986-legal and statutory

requirements for food waste handling, treatment and disposal

UNIT II FOOD INDUSTRY EFFLUENT

9

Characterization of food Industry effluents, physical and chemical parameters- Oxygen demands and their interrelationships, residues (solids), fats, oils and grease-forms of nitrogen, sulphur and phosphorus-anions and cations, surfactants, colour, odour, taste, Toxicity- treatment of food industry effluent, screening, sedimentation floatation.

UNIT III BYPRODUCTS FROM FOOD INDUSTRY

9

Food wastes and by-products related to specific processing industries like fruit and vegetables (apple, orange, mango, potato etc.), dairy industry, oil and oil seeds industry, sugar industry, grains and milling industry, fermentation (alcohol and beer), livestock, poultry, fish and meat

UNIT IV WASTE UTILIZATION

9

Waste utilization from wheat and rice mills, pulse and oilseeds processing-waste utilization from fruit and vegetable industries-fish industry waste utilization - meat and poultry waste recycling-coconut processing-utilization of by-products from fermented foods, milk- case studies involving utilization of whey from dairy industry, utilization of specific plant byproducts for recovery of proteins, pectins, dietary fibres, antioxidants, colorants etc. utilization of biomass for production of animal feed, compost and bio-gas

UNIT V VALUE ADDED PRODUCTS FROM WASTE

9

Value added products from agri food processing industry- uses of rice husk - pyrolysis and gasification of rice husk-cement preparation and different thermal applications-utilization of rice bran- stabilization-defatted bran utilization-fuel briquettes from coconut waste-

TEXT BOOKS

1. Bor S. Luli (ed), "Rice Production and Utilization"
2. Beagle, "Rice Husk Conversion to Energy"

REFERENCES

1. Chereminnoff P. N. & A.C Morresi, "Energy from Solid Wastes" 1976,
2. Chakravarthy & De, "Agricultural Waste and By Product Utilization".

MBTE11	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	37 th , 38 th & 39 th 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-micromachined nanodevices-microprobe arrays-multiple nanoprobles- 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 diagnostics – current techniques & applications”

REFERENCE BOOKS:

1. Microbial bionanotechnology edited by Bernard H.A. Relim
2. Applications of nanoparticles in biology & medicine O.V. Salate. Journal of nanobiotechnology (2004), 2:3

MBTE12		ALTERNATE ENERGY				L	T	P	C
		Total Contact Hours - 45				3	0	0	3
		Prerequisite – Microbiology, Bioprocess Engineering, Chemical engineering							
		Course Designed by – Dept. of Industrial Biotechnology							
OBJECTIVES: To make students familiar with importance of alternative fuels									
COURSE OUTCOMES (COs)									
CO1		Learn limitations of fossil fuels and need for alternative fuels							
CO2		Learn sources of various alternative flues							
CO3		Learn storage, distribution and safety aspects of alternative fuels							
CO4		To have an understanding of engine requirements and combustion characteristics fuels							
CO5		To teach engine requirements and adaptability of engines to alternative fuels							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Merits and demerits of various alternative fuels - Engine requirements

UNIT II PRODUCTION OF FUELS

9

Methods of production - Properties - Blends of gasoline and alcohol - Performance in SI engines – Adaptability - Combustion and emission characteristics - Performance in CI engines -Emission characteristics - Properties of alcohol esters

UNIT III NATURAL GAS

9

Production and properties of CNG, LPG, biogas and producer gas - Performance and emission in SI/CI engines - Storage, distribution and safety aspects

UNIT IV HYDROGEN FUELS

9

Sources of Hydrogen - Properties - Production of hydrogen - Transportation, storage and safety aspects - Performance and emission characteristics – Adaptability - Fuel cell - Hybrid vehicles

UNIT V BIOFUEL

9

Various vegetables oils - Properties - Esterification - Performance and emission characteristics - Bio-diesel: Feed stock, characteristics, preparation (lab and commercial), storage, applications, environmental impacts, economics, policy

TEXT BOOK

1. Osamu Hirao and Richard Pefley (1988), Present and Future Automotive Fuels, Wiley Interscience Publication, New York.

REFERENCE BOOKS

1. R.L. Bechtold (1997), Alternative Fuels Guidebook, SAE
2. Nick Wagoner and Sheryl Wagoner (2006), Alternate Fuels: An Overview, ThomsonDelmar Learning.
3. Reda Mohamed Bata (1994), Alternate Fuels: A Decade of Success and Promise(Progress in Technology), SAE International

MBTE13	PROTEOGENOMICS AND BIOINFORMATICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioorganic chemistry, Basic Biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES					
To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers					
COURSE OUTCOMES (COs)					
CO1	to understand the classification of biological databases and its role in research				
CO2	to apply the concept of genomics of different organism, gene expression and mapping situations				

CO3		to know the tools for gene identification and prediction				
CO4		to know the structural elucidation and prediction of proteins				
CO5		to get a basic knowledge of techniques related to proteomics				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

MBTE14		FOOD SAFETY AND QUALITY CONTROL				L	T	P	C
		Total Contact Hours - 45				3	0	0	3
		Prerequisite – Food process engineering, Microbiology, Bioprocess Engineering, Biochemistry							
		Course Designed by – Dept. of Industrial Biotechnology							
OBJECTIVES: To know about the safety regulations of food industries									
COURSE OUTCOMES (COs)									
CO1		To study the history of food safety regulations							
CO2		to know about food adulteration							
CO3		to understand about food management practices							
CO4		to get basic idea about food hygiene							
CO5		to get basic idea about microbial quality control							
Mapping of Course Outcomes with 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

History of food regulations in India- Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973), Edible Oils Packaging, 1998, Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

UNIT II FOOD SAFETY MANAGEMENT

9

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

UNIT III FOOD QUALITY MANAGEMENT

9

Principles of food quality assurance, total quality management (TQM)–good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

UNIT IV MICROBIAL CONTAMINATION

9

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry Food safety and Standards Act 2006: salient provision and prospects

UNIT V FOOD SAFETY STANDARDS

9

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarius commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

TEXT BOOKS:

1. V. K. Kaushik (1999), Nutrition And Food Safety, Neha Publishers
2. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

REFERENCE BOOKS:

1. Andre, Gordan (2015), Food Safety and Quality Systems in Developing Countries, Elsevier
2. Yasmine Motarjemi (2013), Food Safety Management, 1st Edition, Elsevier

MBTE15	BIOSENSOR TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Basic biotechnology, Bioprocess Engineering				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about the biosensors					
COURSE OUTCOMES (COs)					

CO1		to understand basic principles of biosensor				
CO2		to know about various types of biosensor				
CO3		to know about applications of biosensors in various fields				
CO4		to get some knowledge about transducers in biosensors				
CO5		to learn about the applications of transducers in biosensors				
Mapping of Course Outcomes with 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION 9

Biosensor – principle, construction, components, Advantages and limitations; ISFET, ENFET, ISE

UNIT II TYPES 9

Various biological materials used for biosensor construction - Microbial biosensors, Enzyme biosensor, Tissue based biosensor, Affinity biosensor

UNIT III TRANSDUCERS IN BIOSENSOR-I 9

Potentiometric, Amperometric biosensors - Principle, constructions, and applications- Generations of biosensor Technology

UNIT IV TRANSDUCERS IN BIOSENSOR-II 9

Calorimetric, Optical, Piezo – electric biosensors - Principle, constructions, and applications

UNIT V APPLICATIONS 9

Online/Offline monitoring in bioprocess; Applications in clinical chemistry, medicine, health care, veterinary, agriculture, food and environmental monitoring

TEXT BOOK

1. Alice Cunningham, 2000, “Introduction to Bioanalytical Sensors”, John Wiley & Sons,.
2. Jiri Janata, 2002, “Principles of Chemical Sensors” Plenum Press.

REFERENCE BOOKS

1. F. Schellr, F. Schubert, J. Fedrowitz, BirkhauserVerlag ,1995 “Frontiers in Biosensors”
2. F. Ligler, C. Rowe Taitt, 2002 “Optical Biosensors. Present & Future” Elsevier,
3. Brian Eggins, 2002 “Chemical Sensors and Biosensors” John Wiley & Sons,
4. Graham Ramsay, 1998, ‘Commercial Biosensors’-, John Wiley& Sons.
5. Weblink: nptel

MBTE16		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	37 th , 38 th & 39 th 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 III SAFETY 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 Hemorrhage , 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" 3rd ed.
2. Prof.M.H.Fulekar, 2007, "Industrial Hygiene & chemical Safety" 2nd ed.

REFERENCE BOOKS:

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

MMA01		BIOSTATISTICS		L	T	P	C
		Total Contact Hours - 45		3	0	0	3
		Prerequisite –Maths I and II					
		Course Designed by – Dept of Industrial Biotechnology					
OBJECTIVES: To provide a basic knowledge of probability and statistics							
COURSE OUTCOMES (COs)							
CO1	to understand the basic concepts various theorem in probability						
CO2	to understand the concepts of various problems in probability						

CO3	to know basic concepts random variables					
CO4	to know about sampling concepts					
CO5	to know about design of experiments using various tests					
Mapping of Course Outcomes with 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		M
	CO4	M		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Probability concepts- Baye's theorem – One dimensional two dimensional random variable – Marginal and conditional distribution- Correlation and Regression-Distributions, Binominal, Poisson Normal uniform-Exponential

UNIT II SAMPLING METHODS

9

Methods of sampling- Population – Sample- Simple random sampling- Stratified and systematic sampling-Point and Interval estimates-Sampling errors-Simple size determination- Data types.

UNIT III STATISTICAL PROCESSES

9

Classification of Random processes- Stationary processes- Poisson processes- Binomial processes- Sine wave processes- Markov processes- Markov processes- Markov chains- Auto correlation – properties.

UNIV IV TEST OF SIGNIFICANCE

9

Parametric test: T test-Normal test – Test for proportion- F test – Chi square test – test for contingency table. Non parametric test: Sign test of paired date- Kruskal Wallis test- Rank correlation – Kotrogrov Smirov test.

UNIT V DESIGN OF EXPERIMENTS

9

Completely Randomized Design- Randomized block design-Latin Square design-Factorial

designs.

TEXT BOOK:

1. Kapur J. N and Saxena H. C, "Mathematical Statistics", S. Chand and Co., New Delhi

REFERENCES

1. Veerarajan T, "Probability Statistics and Random Process" Tata McGrawHill, New Delhi
2. S.C. Gupta and V.K. Kapoor, "Applied Statistics", S. Chand and Sons, New Delhi
3. W. W. Daniel, "Biostatistics- A foundation for analysis of health sciences", John Wiley and Sons, New Delhi
4. P.N. Arora and S. Arora, "Statistics for Management", S. Chand and Sons, New Delhi

MBTE17		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						
OBJECTIVES: To provide basic knowledge about Entrepreneurship								
COURSE OUTCOMES (COs)								
CO1		to understand the fundamentals of Entrepreneurship						
CO2		to know about time management and decision making						
CO3		to explore the avenues for financing a business venture						
CO4		to know about various company laws						
CO5		to understand Entrepreneurship in biotechnology						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1		H	H	M			
	CO2	H	H		L	M		
	CO3	H	M	M		M		
	CO4	M		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I ENTREPRENEURSHIP FUNDAMENALS 9

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

UNITII DECISION MAKING AND TIME MANAGEMENT 9

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

UNIT III ENTREPRENEURSHIP – FINANCE AND ECONOMIC FEASIBILITY 9

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

UNIT IV COMPANY LAWS AND REGULATIONS 9

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

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9

Various business opportunities in Biotechnology – Development of Biotech companies in India – Case studies on Biotech companies and its growth

TEXT BOOK

1. Exploring Entrepreneurship: D. Allan Barefield and George F. Smith, Ettmae Westbrook, Tennessee State University, 2006

REFERENCES

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

MBTE18	RESEARCH METHODOLOGY FOR BIOENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about various instrumentation techniques and data documentation					
COURSE OUTCOMES (COs)					
CO1	to understand the biochemical analysis				
CO2	to know about spectroscopic and microscopic techniques				
CO3	to know about the separation techniques				
CO4	to get ideas about ethical issues related to research				

CO5		to know about data documentation				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M	M		M
	CO4	M		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I BASIC PRINCIPLES FOR BIOCHEMICAL ANALYSIS

9

Introduction – preparation of organ and tissue samples for analysis – cell disruption methods – physiological solutions: buffers and growth media for plants, animals and microbes – Medium standardization - cell sorting, isolation and enumeration techniques – cryopreservation – elucidating metabolic pathways by tracer studies.

UNIT II SPECTROSCOPIC AND MICROSCOPY TECHNIQUES

9

Introduction – UV – visible spectroscopy – NMR spectroscopy – IR and Raman spectroscopy – atomic spectroscopy - Introduction to microscopy – Election microscopy –ultramicrotome- phase contrast microscopy – Fluorescent and confocal microscopy.

UNIT III SEPARATION TECHNIQUES

9

Introduction to chromatography and electrophoresis – gel filtration – ion exchange – affinity – GC – HPLC - partition chromatography – electrophoresis of proteins and nucleic acids – immunoprecipitation techniques – ELISA.

UNIT IV ETHICAL ISSUES IN BIOTECHNOLOGY

9

Legal and socio economic impacts of biotech research – bio safety regulation – r-DNA guidelines- issues involved in experimenting with animals – Experimental protocol approvals – contaminant levels and environmental effects- impact of GM organisms and GM foods – IPR and patents.

UNIT V DATA ANALYSIS AND DOCUMENTATION

9

Sampling concepts for statistical analysis – Mean, median, standard deviation, standard error – ANNOVA – Guidelines for thesis writing: literature collection methods – writing of abstract,

introduction and review of literature – results, discussion and summary – guidelines to publish articles in journals.

TEXT BOOKS:

1. Keith Wilson and John Walker, 2004, Practical biochemistry, Principles and techniques – Cambridge publication
2. Dr. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.

REFERENCES

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

**DEPARTMENT OF BIOMEDICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
M.TECH BIO MEDICAL ENGINEERING
(FULL TIME) CURRICULUM & SYLLABUS**

R 2015

(I – VI SEMESTERS) CHOICE BASED CREDIT SYSTEM

**(Applicable to the batches admitted from July 2015)PG-
CURRICULUM I TO IV SEMESTERS (FULL TIME) 2015**

SEMESTER I

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	MBM101	Biomaterials and implantable devices	4	0	0	4
2	PC	MBM102	Anatomy and physiology	3	0	0	3
3	PC	MBM103	Bio signal processing	3	0	0	3
4	PC	MBM104	Biomedical equipment	3	0	0	3
5	PC	MBM105	Biomedical instrumentation	3	0	0	3
6	PE		Professional Elective I	3	0	0	3
PRACTICAL							
7	PC	MBM1L1	Bio medical Instrumentation lab	0	0	4	2
8	PR	MBM1S1	Technical Seminar	0	0	2	1
TOTAL				19	0	6	22

SEMESTER II

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
1	PC	MBM201	Medical Image Processing	3	0	0	3
2	PC	MBM202	Medical Imaging And Radio Therapy	3	0	0	3
3	PC	MBM203	Fiber optics and Laser Instrumentation	3	0	0	3
4	PC	MBM204	Microcontrollers and its Applications	3	0	0	3
5	PE		Professional Elective II				
6	PE		Professional Elective III	3	0	0	3
7	PC	MBM2L1	Biomedical Signal and Image Processing Lab	0	0	4	2
TOTAL				15	0	4	20

SEMESTER III

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PE		Professional Elective IV	3	0	0	3
2	PE		Professional Elective V	3	0	0	3
3	OE		Open Elective I	3	0	0	3
PRACTICAL							
4	PR	MBM3P1	Project Work (phase I) Summer Training Pre-requisite	0	0	12	6
TOTAL				9	0	12	15

SEMESTER IV

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL							
1	PR	MBM4P1	Project Work (phase II)	0	0	24	12
TOTAL				0	0	24	12

OVERALL CREDITS : 69

**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)	18	14	-	-	32	46.38
2	Professional Elective (PE)	3	6	6		15	21.74
3	Open Electives (OE)	-	-	3	-	3	4.37
4	Project Work, Seminar, Internship, Term Paper, etc. (PR)	1	-	6	12	19	27.53
	Total Credit	22	20	15	12	69	100%
	Total Contact Hour	25	22	21	24	93	

LIST OF ELECTIVES

SUB.CODE	SUBJECT NAME	L	T	P	C
PROFESSIONAL ELECTIVE (PE) - I					
MBME089	Advanced biosensor and transducers	3	0	0	3
MBME053	Human assist devices	3	0	0	3
MBME054	Computer based medical Instrumentation.	3	0	0	3
PROFESSIONAL ELECTIVE (PE) –II					
MBME060	Tissue Engineering.	3	0	0	3
MBME056	Health Hospital and Equipment management.	3	0	0	3
MBME067	Brain Control Interfaces	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - III					
MBME061	Bio MEMS	3	0	0	3
MBME058	Physiological modeling	3	0	0	3
MBME059	Pattern recognition Techniques and Applications	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - IV					
MBME055	Advanced Neural computing.	3	0	0	3
MBME063	Wavelet transforms and its application	3	0	0	3
MBME064	Tele Health technology .	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – V					
MBME062	Principles Of Genetic Analysis	3	0	0	3
MBME065	DSP Integrated Circuits	3	0	0	3
MBME052	Advances in Electronics applied to Hospital Engineering	3	0	0	3

SUB.CODE	SUBJECT NAME	L	T	P	C
OPEN ELECTIVE (OE) –I					
MBME057	Rehabilitation Engineering.	3	0	0	3
MBME066	Bio Mechanics	3	0	0	3
MST070	Research Methodology	3	0	0	3

MBM101	Biomaterials and implantable devices										L	T	P	C
	Total Contact Hours: 60										4	0	0	4
	Prerequisite: Basic Biomaterials (B.Tech)													
	Course Designed by : Bio-Medical Engineering													
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.													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs	Programme Outcomes (POs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
2	CO1	H	M	H			H			M				
	CO2					M							L	
	CO3	M		M					M					
	CO4		L								L			
	CO5													
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)			Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
			√											
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

UNIT-I BIOMATERIAL SCIENCE

(9)

Definition and classification of Biomaterials, Application of Polymers-Metals- Ceramics and Composite Biomaterials

UNIT-II BIOLOGICAL MATERIALS

(9)

Structure, Property relationship of Biological Materials- Thermodynamics of Structural changes- Strengthening Mechanisms

UNIT-III BIOCOMPATIBILITY

(9)

Biocompatibility- introduction of Biological environment, Material response function and degradation of materials in vivo- host response- biological effects of implants- Methods of test for biological performance.

UNIT-IV IMPLANT MATERIALS

(9)

Metallic implant materials- Ceramic implant materials- Polymeric implant materials- hard tissue replacement implant.

UNIT-V BIOPOLYMERS

(9)

Physio Chemical Characteristics of Biopolymers- biodegradable polymers for medical purposes- tailor made composite materials for biomedical use-synthetic Polymeric Membranes and their biological applications-biopolymers in .Controlled release systems. Artificial skin surface Modification of biopolymer materials.

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 Nijhoff pub, 1986
4. http://www.asminternational.org/documents/10192/1849770/06974G_Chapter_1.pdf

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM102	ANATOMY AND PHYSIOLOGY								L	T	P	C		
	Total Contact Hours: 45								3	0	0	3		
	Prerequisite: Biology (+2 level)													
	Course Designed by : Bio-Medical Engineering													
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	Understand 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													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs	Programme Outcomes (POs)												
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
		CO01	M	L	H	L	M	M	M	M				
		CO02	M	L	H	L	M	M	M	M				
		CO03	M	L	H	L	M	M	M	M				
		CO04	M	L	H	L	M	M	M	M				
	CO05	M	L	H	L	M	M	M	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)			Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
			√											
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

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 GASTROINTESTINAL AND 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.

TOTAL: 45 PERIODS

REFERENCES

1. Guyton 'Text book of Medical Physiology – WB Jaunders company Philadelphia - 10 edition 2002
2. Cyril 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 Lively Body – BC publication New Delhi 1980
5. <https://www.khanacademy.org/science/health-and-medicine/human-anatomy-and-physiology>

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		

MBM103	Bio-signal processing						L	T	P	C				
	Total Contact Hours: 45						3	0	0	3				
	Prerequisite: Basic Digital Signal Processing (B.Tech/B.E)													
	Course Designed by : Bio-Medical Engineering													
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 filters														
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													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	Cos	Programme Outcomes (Pos)												
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
		CO1	H			M	H		M			M		M
		CO2			M									
		CO3	M			H						M		
		CO4					H		H					
	CO5	H									H			
3	Category	Professional Mathematics (PM)			Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
					√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

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 FECCG, 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

TOTAL: 45 PERIODS

REFERENCES

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.
11. http://home.ee.ntu.edu.tw/classnotes/bme2/2007/6_11_07.pdf

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM104	BIOMEDICAL EQUIPMENT								L	T	P	C	
	Total Contact Hours: 45								3	0	0	3	
	Prerequisite: Basic Knowledge in Equipments												
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering												
OBJECTIVES													
• To provide practice on recording and analysis of different Bio potentials • Study the function of different Therapeutic equipments.													
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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					
	CO5	H									H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
			√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I	CARDIAC CARE UNIT	9
Pacemakers - different types, batteries for pacemakers. AC defibrillators, asynchronous and synchronous DC defibrillators, patient monitoring system.		
UNIT II	NEUROLOGY EQUIPMENT	9
Evoked response - Auditory, Visual and Somato sensory Depth recording, Stereotaxy , EEG controlled Anesthetic monitor, Biofeedback equipments, Spinal reflex Measurement, Transcutaneous nerve stimulator		
UNIT III	PHYSIOTHERAPY AND DIATHERMY EQUIPMENT	9
Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety- Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser		
UNIT IV	LASER AND ULTRASONIC APPLICATION	9
Principles of Laser action, Different types and clinical applications of laser, ultrasonic frequency for medical application, different modes of Display A, B, and C ultrasonic probes, Real time echo and 2D scanner, Application of Ultrasonic for diagnosis.		
UNIT V	RECENT TRENDS	9
Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application , principles of Fibre optics cables, Endoscopy, Laparoscopy, ophthalmic equipments- slit Lamp, Tonometer, Retinal response Plotter, principles of Bio telemetry, principles of Lithotripsy.		

TOTAL: 45 PERIODS

REFERENCES

1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
2. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
3. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
5. Wolbarsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
6. Heinz Kresse – Handbook of Electro medicine. John Wiely & Sons – Chrchester – 1985
7. https://en.wikipedia.org/wiki/Medical_equipment

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM105	BIOMEDICAL INSTRUMENTATION					L	T	P	C					
	Total Contact Hours: 45					3	0	0	3					
	Prerequisite: Basic Instrumentations													
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering													
OBJECTIVES														
The student should be made to:														
• 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													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs	Programme Outcomes (Pos)												
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
		CO1	H			M	H		M			M		M
		CO2			M									
		CO3	M			H						M		
		CO4					H		H					
	CO5	H									H			
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)				
				√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS

9

Categories and Characteristics of Transducer, Signal conditioning units, Multichannel data acquisition system, various types recorders, necessity for low noise pre amplifiers, Difference amplifier, Chopper amplifier, Different types of electrode and its equivalent circuits.

UNIT II BIOPOTENTIAL RECORDING

9

ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform, frequency spectrum, abnormal waveform.

UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS

9

Respiration rate, Pulse rate, Temperature, Blood Pressure, O₂ , CO₂ measurements, Respiratory volume measurement, BMR measurement, Plethysmography technique, Impedance technique- Bipolar and Tetra polar circuits, Detection of various physiological parameters using impedance technique

UNIT IV BLOOD FLOW METER AND BLOOD CELL COUNTER

9

EM and ultrasonic blood flow meters, indicator dilution method, Thermodilution method, Manual and Automatic Counting of RBC, WBC and Platelets.

UNIT V BIO-CHEMICAL MEASUREMENTS& BIOSENSORS

9

pH, pCO₂, pO₂, pHCO₃ and electrophoresis, colorimeter, spectrophotometer, flame photometer, autoanalyser, Biosensors.

TOTAL =45 PERIODS

REFERENCES

1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation , John Wiley and sons Newyork 1975
2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
4. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.

Richard S.Cobbold Transducers for Biomedical Measurements; Principle and applications- John Wiley and sons,1992.

<https://accessengineeringlibrary.com/browse/handbook-of-biomedical-instrumentation-third-edition>

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey

3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM1L1	BIO MEDICAL INSTRUMENTATION LAB								L	T	P	C	
	Total Contact Hours: 45								0	0	4	2	
	Prerequisite: Basic Knowledge to handle Instruments												
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering												
OBJECTIVES													
• To provide practice on recording and analysis of different Bio potentials • Study the function of different Therapeutic equipments.													
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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					
	CO5	H									H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)			Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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.

Course Assessment Methods:

Direct		Indirect	
1	Observation Book	1	Course and Survey
2	Record Book	2	Faculty Survey
3	Model Examination	3	Industry
4	Viva Voce	4	Alumni
5	End Semester Examinations		

MBM201	MEDICAL IMAGE PROCESSING					L	T	P	C				
	Total Contact Hours: 45					3	1	0	4				
	Prerequisite: Knowledge in Image processing (B.Tech/B.E Level)												
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering												
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 techniq												
CO2	Students will be able to understand the various diagnostic applications of the medical imaging techniques.												
CO3	Students will get the clear domain knowledge the image fundamentals and image transfo												
CO4	Study the image enhancement techniques												
CO5	Study the image restoration procedures and image compression procedures.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
		CO1	H	M	H			H			M		
		CO2					M						L
		CO3	M		M					M			
		CO4		L								L	
	CO5			H			H						
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
				√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I

IMAGE FUNDAMENTALS

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 Wiener 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.

TOTAL: 45 PERIODS

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

8. https://en.wikipedia.org/wiki/Medical_imaging

Course Assessment

Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM202	MEDICAL IMAGING AND RADIO THERAPY								L	T	P	C		
	Total Contact Hours: 45								3	0	0	3		
	Prerequisite: Knowledge in Imaging Techniques													
	Course Designed by : Bio-Medical Engineering													
OBJECTIVES														
- To introduce the basics of signal processing and its application to biological systems. - To make the students to understand the fundamentals of image processing and its														
COURSE OUTCOMES (COs)														
CO1	Know the principle behind the production of X-Rays, its types and applications													
CO2	Understand the principle of CT													
CO3	About Gamma camera and radiation detectors													
CO4	Principle of MRI and fMRI													
CO5	Therapeutic effects of various radiation sources													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs	Programme Outcomes (POs)												
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
		CO1	H		H			H			M			
		CO2					M							L
		CO3	M		M									
		CO4		L								L		
	CO5						H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)				
			√											
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

UNIT I X – RAYS

9

Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, dental X- ray units.

UNIT II TOMOGRAPHY

9

Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography.

UNIT III EMISSION IMAGING

9

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT.

UNIT IV MAGNETIC RESONANCE IMAGING

9

Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterisation, MR Spectroscopy, Functional MRI.

UNIT V THERAPY USING X – RAYS AND ISOTOPES

9

Direct and Indirect effects of high energy radiation, Units for radiation Exposer, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

Total= 45 Periods

REFERENCES:

1. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
2. Jacobson B. and Webster J.G., Medicine and Clinical Engineering, Prentice Hall India, New Delhi, 1999.
3. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chichester, 1986.
4. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelphia, 1988.
5. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, Mc Graw Hill Publications, New York,1995
6. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics, Churchill Livingstone, 5th Edition.
7. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince
MRI from picture to proton, Cambridge University press, New York 2006
8. https://en.wikipedia.org/wiki/Radiation_therapy

MBM203	FIBER OPTICS AND LASER INSTRUMENTATION							L	T	P	C		
	Total Contact Hours: 45							3	0	0	3		
	Prerequisite: Knowledge in laser (B.Tech/B.E)												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
- To expose the students to the basic concepts of optical fibres and their properties. - To provide adequate knowledge about the Industrial applications of optical fibres. - To expose the students to the Laser fundamentals. - To provide adequate knowledge about Industrial application of lasers. - To provide adequate knowledge about holography and Medical applications of Lasers													
COURSE OUTCOMES (COs)													
CO1	Fundamental principles of light through an optical fiber and various optical light sources												
CO2	Industrial measurements using optical light and optical sensors												
CO3	Characteristics of LASER and its types/configuration												
CO4	Applications of LASERS												
CO5	Hologram-its definition, basic principle, and medical applications												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		
	CO5						H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)							
			√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light through a fiber- different types of fibres and their properties, transmission characteristics of optical fibre- absorption losses- scattering losses- dispersion- optical fiber measurement- optical sources- optical detectors- LED- LD- PIN and APD.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors- fiber optic instrumentation system- different types of modulators- detectors- application in instrumentation- interferometric method of measuring length- moire fringes- measurement of pressure, temperature, current, voltage, liquid level and strain- fiber optic gyroscope- polarisation maintaining fibers.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers- three level and four level lasers- properties of laser- laser modes- resonator configuration- Q switching and mode locking- cavity dumping- types of lasers: gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect- material processing, laser heating, welding, melting and trimming of materials- removal and vaporisation.

UNIT V HOLOGRAM AND MEDICAL APPLICATION 9

Holography- basic principle: methods, holographic interferometry and applications, holography for non destructive testing- holographic components- medical applications of lasers- laser and tissue interaction- laser instruments for surgery, removal of tumours of vocal cords, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

References:

1. Abdul AL Azzawi, Fibre Optics: Principles and Practices, CRC Press (2006).

KR Nambiar, Lasers: Principles, Types and Applications, New Age International Publishers (2006).

2. https://en.wikipedia.org/wiki/Optical_fiber

MBM204	MICROCONTROLLERS AND ITS APPLICATION						L	T	P	C			
	Total Contact Hours:45						3	0	0	3			
	Prerequisite: Knowledge in Microprocessor (B.Tech/B.E)												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
- To introduce microcontroller, the role of microcontrollers .Types and selection, its application and examples. - To study the microcontroller resources and Family members, bus widths program and data memory parallel ports. D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations - To study Interrupt structures programmable timers, real time clock, latency, interrupt, density and interval constraints. - To study CPU register- structure- addressing modes- instruction sets- assembly languages- assemblers. - To study Queues, tables and strings, program organization, microcontroller expansion methods, I/O hardware alternatives, development tools, RTOS.													
COURSE OUTCOMES (COs)													
CO1	To learn introduce microcontroller the role of microcontrollers. The types and selection.												
CO2	To learn D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations.												
CO3	To have a clear view Interrupt structures programmable timers, real time clock.												
CO4	To learn CPU register its structure and its addressing modes and instruction sets.												
CO5	To learn I/O hardware alternatives, development tools, RTOS, motorola MC68HC11.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1						M						
	CO2		H			H	H						
	CO3		H					H		M			
	CO4	H			H							H	
	CO5			H		M					H		
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			

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

Course Contents:

UNIT I - OVERVIEW OF ARCHITECTURE AND MICROCONTROLLER RESOURCES 9

Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT II - INSTRUCTION SET OF 8051 FAMILY MICROCONTROLLERS 9

Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT III - REAL TIME CONTROL

9

Interrupts: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-Maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051. **Timers:** Programmable Timers in the MCUs – Free running counter and real time control – Interrupt interval and density constraints.

UNIT IV - 8051 PROGRAMMING AND APPLICATIONS

9

Interfacing Serial I/O (8251)- parallel I/O (8255) -Keyboard and Display controller (8279) - ADC/DAC interfacing - Inter Integrated Circuits interfacing (I2C Standard)-LCD- LED and Array of LEDs-Interfacing with the Flash Memory- Prototype MCU based Measuring instruments – Robotics and Embedded control Bus: RS232C-RS485-GPIB8051

UNITV- REAL TIME OPERATING SYSTEM FOR MICROCONTROLLERS 9

Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers. ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development tools.

TEXT BOOKS:

1. Raj Kamal, “*Microcontrollers Architecture, Programming, Interfacing and System Design*”, Pearson Education, 2005.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, “*The 8051 Microcontroller and Embedded Systems*”, Pearson Education Asia, New Delhi, 2003

REFERENCES:

1. Deshmuk.A.V, “*Microcontrollers (Theory & Applications)*”, TMH, 2005.
2. John B. Peatman, “*Design with PIC Microcontrollers*”, Pearson Education, 2005.

3. Kenneth J Ayala, “*The 8051 Microcontroller Architecture Programming and Application*”, 2nd Edition, Penram International Publishers (India), New Delhi, 1996.
4. Rafi Quazzaman.M, “*Microprocessors Theory and Applications: Intel and Motorola*”, Prentice Hall of India, Pvt. Ltd., New Delhi, 2003.
5. <https://en.wikipedia.org/wiki/Microcontroller>

Course Assessment Methods:

Direct		Indirect	
1)	Internal Tests	1	Course and Survey
2)	Assignments	2	Faculty Survey
3)	End Semester Examinations	3	Industry
		4	Alumni

MBM2L1	Biomedical Signal and Image Processing Lab					L	T	P	C				
	Total Contact Hours:					0	0	4	2				
	Prerequisite:												
	Course Designed by : Bio-Medical Engineering												
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 will be able to understand the various diagnostic applications of the medical imaging techniques.												
CO3	Students will get the clear domain knowledge the image fundamentals and image transfo												
CO4	Study the image enhancement techniques												
CO5	Study the image restoration procedures and image compression procedures.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
		CO1	H	M	H			H			M		
		CO2					M						L
		CO3	M		M					M			
		CO4		L								L	
		CO5			H			H					
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)			Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
			√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

1. Representation of time-series; computation of convolution.

2. Response of a difference equation to initial conditions; stability.
3. DFT computation.
4. Computational experiments with digital filtering.
5. Sampling and waveform generation.
6. FIR and IIR filters implementation.
7. Simulation of Biosignals and Analysis of ECG signals, EEG signals and EMG signals.
8. Image arithmetic operations – Addition, Subtraction, Multiplication and Division of 2 images.
9. Gray level transformation – Log transformation, Power law transformation and Histogram equalization.
10. Spatial Filters-Salt and pepper noise, speckle noise, Average Filter and Gaussian Filter
11. Properties of Fourier transform – zeros, FFT Discrete Fourier transform, Two dimensional Discrete Fourier transform.
12. Properties of Fourier transform- FFT SHIFT, IFFT SHIFT

Course Assessment Methods:

Direct		Indirect	
1	Observation Book	1	Course and Survey
2	Record Book	2	Faculty Survey
3	Model Examination	3	Industry
4	Viva Voce	4	Alumni
5	End Semester Examinations		

MBME089	Advanced biosensor and transducers						L	T	P	C			
	Total Contact Hours: 45						3	0	0	3			
	Prerequisite: Basic knowledge of electronic devices and sensors												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.													
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.													
3. 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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1			H									
	CO2			H	H		M						
	CO3		M		H		H						
	CO4	H	M		H								
	CO5			H		H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

Units and Standards - calibration methods - statics calibration - classification of errors, error analysis - statistical methods - odds and uncertainty.

UNIT - II **9**
CHARACTERISTICS OF TRANSDUCERS

Static characteristics - accuracy, precision, sensitivity, linearity etc - mathematical model of transducers - zero first - order and second - order transducers - response to impulse step, ramp and sinusoidal inputs.

UNIT - III **9**
VARIABLE RESISTANCE TRANSDUCERS

Principle of operation, construction details, characteristics and applications of resistance potentiometers, strain gauges, resistance thermometers, thermistors, hot-wire anemometer, piezoresistive sensors and humidity sensors.

UNIT - IV **9**
BIOSENSORS - PHYSIOLOGICAL RECEPTORS - J RECEPTORS

Chemo receptors, Baroreceptors, Touch receptors, Biosensors - Working Principle and Types, Applications.

UNIT - V **9**
OTHER TRANSDUCERS

Piezoelectric transducers, magnetostrictive transducer, IC sensor digital transducers - smart sensor - fibre optic transducers.

TOTAL: 45 PERIODS

Text Books:

1. Doebelin. E. O, Measurement Systems, McGraw Hill Book Co. 1998
2. Renganathan S, Transducer Engineering, Allied Publishers, Chennai, 2000.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME062	PRINCIPLES OF GENETIC ANALYSIS							L	T	P	C		
	Total Contact Hours: 45							3	0	0	3		
	Prerequisite: Basic Knowledge on genetic												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
1. To study the Pattern of inheritance and Chromosomal basis of inheritance.													
2. To know DNA sequencing, DNA Amplification.													
3. To study the Protein synthesis and regulation of gene expression.													
COURSE OUTCOMES (COs)													
CO1	To learn objectives of Chromosome mapping by recombination , Genetics of Bacteriaand viruses.												
CO2	Learn the DNA structure and replication, DNA sequencing, DNA Amplification andDNA Hybridization.												
CO3	To learn Gene isolation and manipulation.												
CO4	To learn Genetic basis of development.												
CO5	Study the Quantitative Genetics and Evolution Genetics.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H					M			
	CO4					H		H					
	CO5	H									H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
			√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I INHERITANCE - GENETIC ANALYSIS

basis of inheritance, Chromosome mapping
Pattern of inheritance, Chromosomaby
recombination, Genetics of
Bacteriaand viruses.

UNIT II DNA AND PHENOTYPE

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.

TOTAL = 45 PERIODS

REFERENCES

1. Watson. J. et al, “ 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.

MBME054	COMPUTER BASED MEDICAL INSTRUMENTATION								L	T	P	C	
	Total Contact Hours: 45								3	0	0	3	
	Prerequisite:												
	Course Designed by : Bio-Medical Engineering												
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.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		
	CO5						H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)			Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)			
			√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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

TOTAL = 45 PERIODS

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

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME060	TISSUE ENGINEERING										L	T	P	C
	Total Contact Hours:45										3	0	0	3
	Prerequisite: Basic biomaterials and artificial organs													
	Course Designed by : Bio-Medical Engineering													
OBJECTIVES 1. To study the Tissue Exchange and Tissue Development. 2. To know the Cell growth and differentiation, Cell and tissue mechanism. 3. 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 aggregation and tissue equivalent.													
CO3	To learn Delivery molecular agents in tissue engineering, control releaser agents in time and space.													
CO4	To learn cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.													
CO5	Study the Replacement in Tissue structure or Functional Tissue engineering cartilage.													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs	Programme Outcomes (POs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
2	CO1	H		H			H			M				
	CO2					M							L	
	CO3	M		M										
	CO4		L								L			
	CO5						H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)								
				√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

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.

TOTAL = 45 PERIODS

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.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME053	HUMAN ASSIST DEVICES					L	T	P	C				
	Total Contact Hours: 45					3	0	0	3				
	Prerequisite:												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
- To know the various biopotential recordings so as to enable students to record various biosignals. - To know the various functional blocks present in cardiac care units so that the students can handle these equipments with care and safety. - To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate. - To study the concept of various 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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H					M			
	CO4					H		H					
	CO5	H									H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)			Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)			
				√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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 Venous 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 haemodialysers, 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.

Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		

SYLLABUS

MBME067		BRAIN CONTROL INTERFACES						L	T	P	C		
		Total Contact Hours:45						3	0	0	3		
		Prerequisite: knowledge on neural networks											
		Course Designed by : Bio-Medical Engineering											
OBJECTIVES													
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 Evoked Potential Based – P300 component.												
CO4	To learn Laplacian Filters their Linear and Non-linear Features.												
CO5	To learn Vector Quantization and Gaussian Mixture Modeling.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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	7
Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential		
Based – P300 component.		
UNIT III	EEG FEATURE EXTRACTION METHODS	10
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	10
LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling –		
Hidden Markov Modeling.		
UNIT V	CASE STUDY	10
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.		

TOTAL = 45 PERIODS

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, BocaRato, 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.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME061		BIO MEMS										L	T	P	C
		Total Contact Hours:45										3	0	0	3
		Prerequisite: Basic electronic and sensors													
		Course Designed by : Bio-Medical Engineering													
OBJECTIVES															
1. To study the Working principle of Microsystems.															
2. To know System modeling and properties of materials.															
3. 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).													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	Cos	Programme Outcomes (Pos)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
2	CO1	H	H	M			H			M				M	
	CO2				H			H			M	H			
	CO3		M			M	H			M					
	CO4			M				H						M	
	CO5	H				M	M				M	H			
3	Category	Professional Mathematics (PM)			Professional Core (PC)			Professional Elective (PE)			Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
								√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016													

UNIT I 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

TOTAL = 45 PERIODS

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.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME058	PHYSIOLOGICAL MODELING								L	T	P	C	
	Total Contact Hours:45								3	0	0	3	
	Prerequisite: basic knowledge anatomy& physiology												
	Course Designed by : Biomedical												
OBJECTIVES													
1. To study the concept and different mathematical techniques applied in analyzing any given system													
2. To learn the analysis of given system in time domain and frequency domain													
3. 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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Co s	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)							
				√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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, Oculo Motor System, Endocrine control system and Modeling of receptors.

L =45 TOTAL = 45 PERIODS

REFERENCES

1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.
2. Manfredo Clynes 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

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME059	PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS							L	T	P	C		
								3	0	0	3		
	Prerequisite:												
Course Designed by : Bio-Medical Engineering													
OBJECTIVES													
1.To study the concept and different supervised learning techniques applied in Bayesian parameter estimation any given system													
2. To know the various functional hierarchical clustering, minimum distance Pattern classifier.													
3. To study the stability analysis feature selection through functional approximation													
4.To study the concept of fuzzy syste.													
COURSE OUTCOMES (COs)													
CO1	Analyze the time Discriminant functions and Supervised learning mathematical techniques.												
CO2	Learn the Clustering for unsupervised learning and classification												
CO3	fuzzy automata and languages- fuzzy control method- fuzzy decision making.												
CO4	Study the Target classification of Cancer cells and Cell cytology classification.												
CO5	Binary selection Elements of formal grammars, syntactic description.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	
3	Category	Professional Mathematics (PM)			Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	
								√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation - Perceptron Algorithm-LMSE Algorithm-Problems with Bayes Approach-Pattern classification by distance functions - minimum distance Pattern classifier.

Clustering for unsupervised learning and classification ,clustering concepts C- means algorithm - hierarchical clustering - Graph theoretic approach to pattern clustering- Validity of clustering solutions.

KL Transforms - feature selection through functional approximation - Binary selection
Elements of formal grammars, syntactic description, stochastic grammars, Structural
representation.

Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – fuzzy automata and languages- fuzzy control method- fuzzy decision making.

Principle of neuro fuzzy techniques, Application of PR in image segmentation - Credit scoring - Techniques for colon endoscopy - Target classification of Cancer cells - Cell cytology classification

1. Duda R.O., and Hart P.G., Pattern Classification and scene analysis, JohnWiley, New York, 1973.
2. Robert J. Schalkoff , Pattern recognition: Statistical, Structural and Neural approaches, John Wiley and SonsInc, New York, 1992.
3. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.
4. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London,1999.
5. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
6. Timothy Ross, Fuzzy Logic with Engineering applications, 2nd Edition John Wiley and sons, West Sussex, 2004.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME056	HEALTH HOSPITAL AND EQUIPMENT MANAGEMENT								L	T	P	C	
	Total Contact Hours:45								3	0	0	3	
	Prerequisite: Basic Principle of management												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
To expose the students for planning and operation of hospitals in a detailed manner which 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 protectequipment 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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I HEALTH SYSTEM

9

Health organisation of the country, the State, the Cities and the Region, Health Financing System, Organisation of Technical Section

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.

FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPO.

Organising Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance.

Function of Clinical Engineer, Role to be performed in Hospital, Manpower Market, Professional Registration, Structure in Hospital.

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, Vera Dammann (Ed.), Hospital Engineering in Developing Countries, Z Report, Eschbom, 1986
4. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. San Deigo 1988
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

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME063	WAVELET TRANSFORMS AND ITS APPLICATIONS							L	T	P	C		
	Total Contact Hours:45							3	0	0	3		
	Prerequisite: basic knowledge wavelet transformation												
	Course Designed by : Electronic												
OBJECTIVES													
1. To study the Series expansion of signals, Multi resolution concepts.													
2. To know Impulse trains and Poisson sum formula, DFT, DTFT, DTFS.													
3. To study the Analysis of multi channel and modulated filter banks.													
COURSE OUTCOMES (COs)													
CO1	To learn objectives of Signal Processing – Continuous, Discrete and Multi rate discrete time signal processing .												
CO2	Learn the Discrete time Wavelet series and properties.												
CO3	To learn Properties of scaling function and wavelet.												
CO4	To learn Approximation of scaling coefficients by sample of the signal and by scaling function projection.												
CO5	Study the wavelet compression of medical images. Video compression, denoising and edge detection.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Co s	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)							
				√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

UNIT I FUNDAMENTALS OF SIGNAL DECOMPOSITIONS 9

Series expansion of signals, Multi resolution concepts – Hilbert spaces – Vectors space and inner products, complete inner product spaces, orthogonal and general

basis. Fourier theory and sampling – Fourier transform, Fourier series, direct function, Impulse trains and Poisson sum formula, DFT, DTFT, DTFS. Signal Processing – Continuous, Discrete and Multi rate discrete time signal processing. Time frequency representation.

UNIT II DISCRETE TIME BASIS AND FILTER BANKS 9

Series expansion of DTS – DTFS, Haar expansion of DTS, Sinc expansion of DTS. Tree – Structured filter banks – Octave-band filter bank, Discrete time Wavelet series and properties, Multi resolution, Interpretation, Wavelet packets. Multi channel filter banks – Block and lapped orthogonal transforms, Analysis of multi channel and modulated filter banks. Multi dimensional filter banks – Analysis and Synthesis.

UNIT III MULTI RESOLUTION CONCEPT AND MODULATED BASES 9

Multi resolution analysis – Wavelet function, DWT. bases, orthogonal basis and biorthogonal bases. Scaling function, scaling coefficients, Wavelet and wavelet coefficients – Scaling function and wavelet. Properties of scaling function and wavelet. Parameterization of scaling coefficients. Calculating the basic scaling function and wavelet. Local cosine bases – Rectangular window, smooth window and general window.

UNIT IV WAVELET SYSTEM DESIGN 9

Daubechies method for zero wavelet moment design. Non-maximal regularity wavelet design. Relation of zero wavelet moments to smoothness, Approximation of scaling coefficients by sample of the signal and by scaling function projection. Tiling the time frequency and time scale plane.

UNIT V APPLICATIONS 9

Wavelet, wavelet packets and matching pursuits with bio medical applications – analysis of phono cardiogram signals, feature extraction for neuro physiological signals, speech enhancements for hearing aids. Wavelets in medical imaging – wavelets applied to mammograms, adapted wavelet encoding in fMRI, wavelet compression of medical images. Video compression, denoising, edge detection, and discrete wavelength multi tone modulation.

L =45 TOTAL = 45 PERIODS

REFERENCES

1. M.Vetterli and J. Kovacevic, 'Wavelets and sub band coding', Prentice Hall, 1995.
2. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, 'Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
3. Metin Akay, 'Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
4. Raguveer m Rao & Ajith S. Bopardikar, 'Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998
5. S.Mallet, 'A Wavelet tour of signal processing', Academic Press 1998

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME064	TELEHEALTH TECHNOLOGY					L	T	P	C				
	Total Contact Hours:45					3	0	0	3				
	Prerequisite: basic knowledge about telemedicine												
	Course Designed by : Biomedical												
OBJECTIVES 1. To study the Series History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine. 2. 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. 320 series (Video phone based ISBN).												
CO4	To learn Basic parts of teleradiology system.												
CO5	Introduction to robotics surgery, tele surgery, Tele cardiology and Teleoncology.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Co s	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)							
				√									
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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 confidentiality 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.

L=45 TOTAL = 45 PERIODS

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. Bemmell, 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. Bemmell, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME057	REHABILITATION ENGINEERING					L	T	P	C				
	Total Contact Hours:45					3	0	0	3				
	Prerequisite: Knowledge in artificial organs												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
1.To develop an understanding of the various rehabilitation aid principle and its working.													
2.To give various information about rehabilitation medicine and Advocacy.													
COURSE OUTCOMES (COs)													
CO1	CO01: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												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
								√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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

RÉHABILITATION ENGINEERING TECHNOLOGIES:**UNIT V****PRINCIPLES****OF APPLICATION****9**

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

Total = 45 PERIODS**REFERENCES**

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

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME065	DSP INTEGRATED CIRCUITS					L	T	P	C					
	Total Contact Hours:45					3	0	0	3					
	Prerequisite: basic knowledge signal processing													
	Course Designed by : Electronic													
OBJECTIVES														
1. To study Standard digital signal processors.														
2. To know Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.														
COURSE OUTCOMES (COs)														
CO1	To learn objectives of Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design.													
CO2	Learn the Principles of Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm.													
CO3	To learn FIR filters, FIR filter structures and FIR chips.													
CO4	To learn DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors.													
CO5	Study the Conventional number system, Redundant Number system, Residue Number System and Bit-parallel.													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	Co s	Programme Outcomes (Pos)												
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
		CO1	M		M			H			M			H
		CO2				H			M			M		
		CO3		M			M	H		H	M			
		CO4			M								H	M
		CO5	H		M		M	M				M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)								
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016												

**UNIT I DSP INTEGRATED CIRCUITS AND
VLSI CIRCUIT TECHNOLOGIES**

9

Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process

technologies, Trends in CMOS technologies.

UNIT II DIGITAL SIGNAL PROCESSING 9

Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal-processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.

UNIT III DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS 9

FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT IV DSP ARCHITECTURES AND SYNTHESIS 9 **OF DSP ARCHITECTURES**

DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures. Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

ARITHMETIC UNITS AND INTEGRATED CIRCUIT

UNIT V DESIGN 9

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolator as case studies. CORDIC algorithm.

L = 45 TOTAL = 45 PERIODS

REFERENCES

1. Lars Wanhammar, “DSP Integrated Circuits”, 1999 Academic press, New York
2. A.V.Oppenheim et.al, “Discrete-time Signal Processing”, Pearson Education, 2000.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, “ Digital signal processing – A practical approach”, Second Edition, Pearson Education, Asia.
4. KeshabK.Parhi, “VLSI Digital Signal Processing Systems design and Implementation”, John Wiley & Sons, 1999.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME052		ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING								L	T	P	C
		Total Contact Hours: 45								3	0	0	3
		Prerequisite: Basic electronic application											
		Course Designed by : Bio-Medical Engineering											
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											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		
	CO5						H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)			Professional Elective (PE)		Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
						√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

Need for Standardization, Medical standards and recalibration, Hospital design, Hospital safety Regulations, hospital Management and Legal aspects.

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.

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.

Principles of EMI, computation Of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this unit from interference

Basic concepts of Virtual Environment , Human Factors and Human Perception, Computer graphics principles used in VR, Modeling of a Virtual Environment ,Existing tools, Avatars, Sensors for Perception, Tracking, Camera, Head mount display used in VR, Applications of Virtual Reality in Medicine

TOTAL = 45 PERIODS

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

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME055	ADVANCED NEURAL COMPUTING						L	T	P	C			
	Total Contact Hours:45						3	0	0	3			
	Prerequisite: Knowledge in neural networks												
	Course Designed by : Bio-Medical Engineering												
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 humans' central nervous systems inspired the concept of artificial neural networks.												
CO4	Applications in ANN												
CO5	Capability of approximating non linear functions of their												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
									√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

**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

Back Propagation Network, Generalised 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 Organising 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, NeocognitronEvolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

TOTAL = 45 PERIODS

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 ,PrenticeHallinternationalInc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley,India 1999.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME066	BIO-MECHANICS							L	T	P	C		
	Total Contact Hours:45							3	0	0	3		
	Prerequisite: Knowledge in tissue engineering												
	Course Designed by : Bio-Medical Engineering												
OBJECTIVES													
1. Introduction to bio-mechanics.													
2. To know mechanical properties of soft biological tissues.													
COURSE OUTCOMES (COs)													
CO1	To learn Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity and non Newtonian viscosity.												
CO2	Learn the Flow properties of blood, effect of shear rate. CO03- To learn Orthopedic biomechanics.												
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.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	Co s	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	M	L	H	L	M	M M	M					
	CO2	M	L	H	L	M	M M	M					
	CO3	M	L	H	L	M	M M	M					
	CO4	M	L	H	L	M	M M	M					
	CO5	M	L	H	L	M	M	M	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)				
							√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016											

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.

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.

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

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

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

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MST070	RESEARCH METHODOLOGY								L	T	P	C			
	Total Contact Hours:45								3	0	0	3			
	Prerequisite: basic knowledge on Management														
	Course Designed by : Management														
OBJECTIVES															
1. To Get adequate knowledge about research concepts															
2. To describe mathematical modeling and simulation															
3. To understand experimental modeling															
4. To get knowledge about the interpretation of result															
COURSE OUTCOMES (COs)															
CO1	To describe research concepts.														
CO2	To Get adequate knowledge about mathematical modeling														
CO3	To describe experimental modeling														
CO4	To understand analysis of results.														
CO5	To know about report writing														
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	Co s	Programme Outcomes (Pos)													
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
		CO1	M		M			H			M			H	
		CO2				H			M			M			
		CO3		M			M	H		H	M				
		CO4			M								H	M	
		CO5	H		M		M	M				M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)									
					√										
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016													

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis”, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments”, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, „Design of Experiments”, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management”, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design”, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education”, PHI Publication.
5. Adler and Granovsky, „Optimization of Engineering Experiments”, Meer Publication
6. S. S. Rao, „Optimization Theory and Application”, Wiley Eastern Ltd., New Delhi, 1996.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

CURRICULUM & SYLLABUS (R2015)**CHOICE BASED CREDIT SYSTEM****M.Tech-CONSTRUCTION ENGINEERING MANAGEMENT****FULL TIME****I – IV SEMESTERS**

SEMESTER I							
S.No	Category	Code No.	Course Title	L	T	P	C
Theory							
1	PM	MMA104	Statistical Methods and Queuing Theory	3	1	0	4
2	PC	MCM101	Modern Construction Materials	3	0	0	3
3	PC	MCM102	Construction Equipment and Management	3	0	0	3
4	PC	MCM103	Project Formulation and Appraisal	3	0	0	3
5	PE	MCM1E1	Professional Elective I	3	0	0	3
6	PE	MCM1E2	Professional Elective II	3	0	0	3
Total				18	1	0	19

SEMESTER II							
S.No	Category	Code No.	Course Title	L	T	P	C
Theory							
1	PC	MCM201	Advanced Construction Techniques	3	0	0	3
2	PC	MCM202	Contract Laws and Regulations	3	0	0	3
3	PC	MCM203	Construction Planning, Scheduling and Control	3	0	0	3
4	PC	MCM204	Safety Practices in Construction	3	0	0	3
5	PE	MCM2E3	Professional Elective III	3	0	0	3
6	PE	MCM2E4	Professional Elective IV	3	0	0	3
Practical							
7	PC	MCM2L1	Advanced Construction Engineering Laboratory	0	0	4	2
Total				18	0	4	20

SEMESTER III							
S.No	Category	Code No.	Course Title	L	T	P	C
1	PR	MCM3P1	Project Work (Phase-1)	0	0	12	6

2	PC	MCM301	Computer Applications in Construction Engineering and Planning	3	0	0	3
3	PE	MCM3E5	Professional Elective V	3	0	0	3
4	OE	MCM3E6	Open Elective	3	0	0	3
			Total	12	0	12	15

SEMESTER IV							
S.No	Category	Code No.	Course Title	L	T	P	C
1	PR	MCM4P1	Project Work (Phase – II)	0	0	24	12
			Total	0	0	24	12

Overall Credits for the Programme – 66

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 Mathematics (PM)	4	-	-	-	4	6.060
1	Professional Core (PC)	9	14	3	-	26	39.393
2	Professional Electives (PE)	6	6	3	-	15	22.727
3	Open Electives (OE)	-	-	3	-	3	4.545
4	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	6	12	18	27.272
	Total Credits	19	20	15	12	66	100
	Total Contact Hours	18	22	24	24	88 Hrs	

LIST OF ELECTIVES

List of Professional Elective (PE) - I

S.No	Code No.	Course Title	L	T	P	C
1	MCM056	Construction Project Management	3	0	0	3
2	MCM057	Quantitative Techniques in Management	3	0	0	3
3	MCM058	Construction Personnel Management	3	0	0	3
4	MCM061	Resource Management and Control in Construction	3	0	0	3
5	MCM062	Project Safety Management	3	0	0	3

List of Professional Elective (PE) - II

S.No	Code No.	Course Title	L	T	P	C
1	MCM051	Advanced Concrete Technology	3	0	0	3
2	MCM060	Quality Control and Assurance in Construction	3	0	0	3
3	MCM065	Maintenance and Rehabilitation of Structures	3	0	0	3

List of Professional Elective (PE) - III

S.No	Code No.	Course Title	L	T	P	C
1	MCM053	System Integration in Construction	3	0	0	3
2	MCM070	Infrastructure Development	3	0	0	3

List of Professional Elective (PE) - IV

S.No	Code No.	Course Title	L	T	P	C
1	MCM052	Construction of Pavements	3	0	0	3
2	MCM067	Prefabrication and Construction Techniques	3	0	0	3

List of Professional Elective (PE) - V

S.No	Code No.	Course Title	L	T	P	C
1	MCM064	Energy-Efficient Buildings	3	0	0	3
2	MCM071	Building Services	3	0	0	3

List of Open Elective (OE)

S.No	Code No.	Course Title	L	T	P	C
1	MCM059	Business Economics and Finance Management	3	0	0	3
2	MCM063	Management Information Systems	3	0	0	3
3	MCM054	Energy Conservation Techniques in Building Construction	3	0	0	3
4	MCM066	Condition Assessment and Evaluation Engineering	3	0	0	3
5	MCM068	Design of Industrial Structures	3	0	0	3
6	MCM069	GIS in Construction Engineering & Management	3	0	0	3
7	MCM072	Research Methodology	3	0	0	3

SYLLABUS

MMA 104		STATISTICAL METHODS AND QUEUEING THEORY			L	T	P	C
		Total Contact Hours: 60			3	1	0	4
		Prerequisite: Numerical Methods						
		Course Designed by : Department of civil						
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)								
CO1		Analyze the one dimensional random variable and their properties and functions.						
CO2		Analyze and study about the estimation theory using various methods.						
CO3		Analyze and test the hypotheses based on different distributions and attributes.						
CO4		Analyze the variance and perform randomised block and latin square design.						
CO5		Analyze and work on different queuing models.						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H		M	L			
	CO2	M		H		L		
	CO3	L	M			H		
	CO4	H		M	L			
	CO5	L		M		H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√						

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

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-QUEUING MODELS

9+3

Poisson Process – Markovian queues – Single and Multi Server Models – Little's formula Machine Interference Model – Steady State analysis – Self Service queue.

TOTAL: 60 PERIODS

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 for Engineers and Scientists, 7th edition, Pearson Education, Delhi, 2002.
5. Vohra, N.D. "Quantitative Techniques in Management", Tata McGraw – Hill Company Limited, 2007.
6. Gupta, S. C. and Kapoor, V. K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2001.
7. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi , 2002.

MCM 101	MODERN CONSTRUCTION MATERIALS			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Concrete technology						
	Course Designed by : Department of civil						
OBJECTIVES : To bring about an exposure to design concepts structures, the loads, systems, structural materials, design procedures, repair and rehabilitation of systems.							
COURSE OUTCOMES (COs)							
CO1	Identify the various types of concretes and their constituents and properties.						
CO2	Identify the various types of metals, their properties and applications.						
CO3	Identify the various composite materials, their properties and applications.						
CO4	Understand the concept of water-proofing and identify the purpose of flooring and facade materials.						
CO5	Design and develop smart intelligent 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	
L	CO1	H			L		
	CO2	H			L	L	
	CO3	H			L		
	CO4	M	L		L		
	CO5	H	M	L		L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT I-SPECIAL CONCRETES	10
Concretes, Behaviour of concretes - High Strength and High Performance Concrete – Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete.	
UNIT II-METALS	10
Steels - New Alloy Steels – Aluminum and its Products –Coatings to reinforcement – Applications.	
UNIT III-COMPOSITES	10
Plastics –Reinforced Polymers – FRP – Applications	
UNIT IV-OTHER MATERIALS	10
Water Proofing Compounds – Non-weathering Materials – Flooring and Façade Materials	
UNIT V-SMART AND INTELLIGENT MATERIALS	5
Smart and Intelligent Materials for intelligent buildings - Special features	

TOTAL: 45 PERIODS

REFERENCES:

1. Santhakumar A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
3. Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
5. Aitkens , High Performance Concrete, McGraw Hill, 1999
6. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
7. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.
8. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.

MCM 102	CONSTRUCTION EQUIPMENT AND MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Construction techniques equipment and practices				
	Course Designed by : Department of civil				
OBJECTIVES : To introduce various construction equipment and study the efficient utilization of the same using scientific principles.					
COURSE OUTCOMES (COs)					

CO1		Manage the equipment, cost control and maintenance of a project.				
CO2		Identify and understand the working principle of earthwork equipments.				
CO3		Identify and understand the working of various equipments for different construction process.				
CO4		Identify and understand the working principle of material handling equipments.				
CO5		Understand the working of aggregate production and concreting equipments.				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	L		M	
	CO2	H			L	
	CO3	H	L		L	
	CO4	M	L			
	CO5	H	M		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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.Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi. 1983.

MCM 103	PROJECT FORMULATIONS AND APPRAISAL		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Management concepts for civil engineers					
	Course Designed by : Department of civil					
OBJECTIVES : To introduce and study formulation, costing, appraisal and finance of construction projects.						
COURSE OUTCOMES (COs)						
CO1	Formulate and generate the project and prepare reports for executing the work.					
CO2	Understand the costing and cash flows of a project.					
CO3	Assess various methods of project appraisal.					
CO4	Understand the project financing and special schemes.					
CO5	Know about private sector participation in Infrastructure Development Projects.					

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1		H	M	L	L
	CO2	H	L			
	CO3		M		L	
	CO4	M	M			L
	CO5	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.

MCM 201		ADVANCED CONSTRUCTION TECHNIQUES			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Concrete technology						
		Course Designed by : Department of civil						
OBJECTIVES : To bring about a complete understanding of advanced construction techniques in sub structure super structure and repair construction.								
COURSE OUTCOMES (COs)								
CO1		Understand the various processes involved in sub-structure construction.						
CO2		Understand the various processes involved in super-structure construction.						
CO3		Understand the construction process of special structures and offshore structures.						
CO4		Know about the rehabilitation techniques carried out for a structure.						
CO5		Know about the demolition techniques carried out for a structure.						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	M	H		L	L		
	CO2	M	H		L	L		
	CO3	M	H			L		
	CO4	M	H			L		

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

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 – insitu prestressing 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.

TOTAL: 45 PERIODS

REFERENCES:

1. Robert Wade 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", Galgotia Publications Pvt. Ltd., 2001.

Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

MCM 202	CONTRACT LAWS AND REGULATIONS			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Estimation and Costing						
	Course Designed by : Department of civil						
OBJECTIVES : To study contract laws and regulations so that adequate knowledge on formulating and managing construction contracts is gained.							
COURSE OUTCOMES (COs)							
CO1	Know the elements of concluding and the process of administering contracts.						
CO2	Understand the various processes involved in tenders.						
CO3	Achieve awareness on arbitrations and powers and duty of an arbitrator.						
CO4	Know about the legal requirements and the corresponding government laws.						
CO5	Know about the labour requirements and administration and the corresponding government laws.						
Mapping of Course Outcomes with 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	M	M				
	CO2	H	L		L		
	CO3	M				L	
	CO4	M			L		
	CO5	M			L		

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

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

TOTAL: 45 PERIODS

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.

MCM 203		CONSTRUCTION PLANNING, SCHEDULING AND CONTROL			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Management concepts for civil engineers						
		Course Designed by : Department of civil						
OBJECTIVES : To study the finer aspects of planning, scheduling and controlling of construction projects.								
COURSE OUTCOMES (COs)								
CO1		Know the elements of construction planning and estimating activity durations and resource requirements.						
CO2		Know the elements of scheduling and to apply appropriate tools and techniques like networks and coding systems.						
CO3		Understand the monitoring and accounting of projects through cost control.						
CO4		Know the elements of quality control and safety of construction projects.						
CO5		Know the concept of gathering and using project information.						
Mapping of Course Outcomes with 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	M		L			
	CO2	H	M		L			
	CO3	H	L		L			
	CO4	H	M					
	CO5	H		L		L		

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

UNIT I-CONSTRUCTION PLANNING

9

Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships among Activities - Estimating Activity Durations - Estimating Resource Requirements for Work Activities - Coding Systems

UNIT II-SCHEDULING PROCEDURES AND TECHNIQUES

9

Construction Schedules - Critical Path Method – Scheduling Calculations - Float - Presenting Project Schedules - Scheduling for Activity-on-Node and with Leads, Lags, and Windows - Scheduling with Resource Constraints and Precedences - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Durations - Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Tradeoffs - Improving the Scheduling Process.

UNIT III-COST CONTROL, MONITORING AND ACCOUNTING

9

The Cost Control Problem - The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates - Relating Cost and Schedule Information.

UNIT IV-QUALITY CONTROL DURING CONSTRUCTION

9

Quality Concerns in Construction - Organizing for Quality - Work and Material specifications - Total Quality Control - Quality Control by Statistical Methods - Statistical Quality Control with Sampling by Attributes - Statistical Quality Control with Sampling by Variables

UNIT V-ORGANIZATION AND USE OF PROJECT INFORMATION

9

Types of Project Information - Accuracy and Use of Information - Computerized Organization and Use of Information - Organizing Information in Databases - Relational Model of Databases - Other Conceptual Models of Databases - Centralized Database Management Systems - Databases and Applications Programs - Information Transfer and Flow.

TOTAL: 45 PERIODS

REFERENCES:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.

2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
4. Willis, E. M., Scheduling Construction Projects, John Wiley & Sons, 1986.
5. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

MCM 204		SAFETY PRACTICES IN CONSTRUCTION				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Building Construction							
		Course Designed by : Department of civil							
OBJECTIVES : To study various safety practices that has to be adopted in construction and to know the finer aspects of safety programs, sampling and audit.									
COURSE OUTCOMES (COs)									
CO1		Know the safety concepts that have to be adopted in construction.							
CO2		Understand the elements of safety programmes.							
CO3		Know the awareness on safety practices that has to be ensured during construction.							
CO4		Know about the accident prevention, safety sampling and audit.							
CO5		Know the safety concepts in hand tools, grinding, lifting works and while operating fire fighting equipments.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H			M	M			
	CO2	L			L				
	CO3	M	L		L				
	CO4	H	L			L			
	CO5	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-SAFETY CONCEPTS

9

Construction accidents - Construction Safety Management: Importance - causes of accident, safety measures- Environmental issues in construction-Construction industry related laws. Human factors in safety – legal and financial aspects of accidents in construction – occupational and safety hazard assessment.

UNIT II-SAFETY PROGRAMMES

9

Safety Programmes - Construction Safety - Elements of an Effective Safety Programmes - Job-site assessment - Safety Meetings - Safety Incentives. Contractual Obligations - Safety in construction contracts- Substance Abuse - safety Record Keeping.

UNIT III-SAFETY PRACTICES

9

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 IV-SAFETY SAMPLING AND AUDIT

9

Accident prevention-cost of accidents-Safety and productivity-safety provision in the factories act-accident reporting investigation and statistics-total loss control and damage control-Safety sampling- safety audit - critical incident technique- safety equipment - planning and site preparation- safety system of storing construction materials-Excavation - blasting- timbering-scaffolding- safe use of ladders- safety in welding.

UNIT V-SAFETY IN LIFTING AND FIRE

9

Safety in hand tools- Safety in grinding- Hoisting apparatus and conveyors- Safety in the use of mobile cranes-Manual handling- Safety in demolition work- Trusses, girders and beams- First-aid- Fire hazards and preventing methods-Interesting experiences at the construction site against the fire accidents.

TOTAL: 45 PERIODS

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. Hand Book on Construction Safety Practices, SP:70, BIS, 2001.

MCM 2L1		ADVANCED CONSTRUCTION ENGINEERING		L	T	P	C
		LABORATORY					
		Total Contact Hours: 30		0	0	4	2
		Prerequisite: Construction Engineering Laboratory					
		Course Designed by : Department of civil					
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)							
CO1		Know the Mix design of concrete as per IS, ACI & BS methods for high performance concrete.					
CO2		Understand the Flow Characteristics of Self Compacting concrete.					
CO3		Know the Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.					
CO4		Perform NDT on hardened concrete.					
CO5		Know the Permeability tests on hardened concrete.					
Mapping of Course Outcomes with 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			L	L	
	CO2				L		
	CO3	M	L		L		
	CO4		M				
	CO5		L		L		

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

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

TOTAL: 30 PERIODS

MCM 301	COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Building Construction				
	Course Designed by : Department of civil				
OBJECTIVES : To bring about an understanding of use of computers for solving scheduling and other related problems by applying critical path methods.					
COURSE OUTCOMES (COs)					
CO1	Know the system hardware and system management.				
CO2	Understand the optimisation techniques and software problems.				

CO3		Know the Deterministic and Probabilistic Inventory Models.				
CO4		Know the scheduling techniques.				
CO5		Understand other concepts regarding estimation, planning, scheduling and accounting.				
Mapping of Course Outcomes with 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	M	L		H	
	CO2	L		M		L
	CO3		M		L	
	CO4		M		M	
	CO5	H				L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-INTRODUCTION

9

Introduction to System Hardware – Languages – Feasibility study and analysis – procurement, training, implementation and system management – procedural language - developing application with spread sheet -developing application with files and database software.

UNIT II-OPTIMIZATION TECHNIQUES

9

Linear, Dynamic and Integer Programming - Branch and Bound Techniques – Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems – Software applications

UNIT III-INVENTORY MODELS

9

Deterministic and Probabilistic Inventory Models - Software applications

UNIT IV-SCHEDULING APPLICATION

9

PERT and CPM - Advanced planning and scheduling concepts – Computer applications – case study.

UNIT V-OTHER PROBLEMS**9**

Estimating – project planning and scheduling- accounting and cost engineering – Enterprises –
Introduction to ERP systems - operations simulation

TOTAL: 45 PERIODS**REFERENCES:**

1. Billy E.Gillet., Introduction to Operations Research – A Computer Oriented Algorithmic Approach, Tata Mc Graw Hill, 1990
2. Paulson, B.R., Computer Applications in Construction, Mc Graw Hill, 1995
3. Feigenbaum,L., Construction Scheduling with Primavera Project Planner Prentice Hall Inc., 2002

Ming Sun and Rob Howard, “Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, London and New York, 2004.

MCM 051		ADVANCED CONCRETE TECHNOLOGY				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Concrete Technology							
		Course Designed by : Department of civil							
OBJECTIVES : To study the properties of concrete, special types of concrete, concreting techniques and mix design procedure.									
COURSE OUTCOMES (COs)									
CO1		Know the concrete making materials.							
CO2		Understand the properties of fresh and hardened concrete.							
CO3		Know the Mix design adopted for casting of concrete.							
CO4		Know the special types of concrete.							
CO5		Understand the various concreting methods adopted.							
Mapping of Course Outcomes with 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	M	M		L				
	CO2	L	M			H			
	CO3	M	M		L				
	CO4	L	M						

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

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 - underwater concrete, special form work.

TOTAL: 45 PERIODS

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.

MCM 052		CONSTRUCTION OF PAVEMENTS				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Transportation Engineering							
		Course Designed by : Department of civil							
OBJECTIVES : To bring about an understanding of construction of pavements and the properties of pavements.									
COURSE OUTCOMES (COs)									
CO1		Know the materials in pavement construction.							
CO2		Understand the design and properties of bituminous mixtures.							
CO3		Know the properties of pavement quality and the construction practice.							
CO4		Know the road making machineries.							
CO5		Be aware of the latest advancements in pavement 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	M	L			L			
	CO2	H	H		M				
	CO3	M			L				
	CO4	H	L	M					
	CO5		M						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				✓					

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

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-PROPERTIES OF 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.

TOTAL: 45 PERIODS

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.

MCM 053	SYSTEM INTEGRATION IN CONSTRUCTION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Maintenance and Rehabilitation of structures				
		Course Designed by : Department of civil				
OBJECTIVES : To study and understand the construction system integration, environmental factors, services, maintenance and safety systems.						
COURSE OUTCOMES (COs)						
CO1	Know about the structural integration and systems					
CO2	Understand the environmental factors and its relevant structural integration.					
CO3	Know the services regarding plumbing and electricity.					
CO4	Know the maintenance techniques and the materials involved.					
CO5	Understand the safety and preventive 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	M	M		L	
	CO2		H			H
	CO3	M				L
	CO4	L			M	
	CO5					L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS**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 Martiz Vinden Barg, 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.

MCM 054	ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Repair and rehabilitation of structures				
	Course Designed by : Department of civil				
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)					

CO1	Know the energy production systems and energy economic analysis.					
CO2	Understand the environmental aspect and resource conservation.					
CO3	Know the energy efficient design strategies.					
CO4	Know the energy audit, energy flow diagram and energy consumption.					
CO5	Understand the concepts of energy management programme.					
Mapping of Course Outcomes with 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		M	
	CO2				L	H
	CO3	H	H			
	CO4		M		L	
	CO5	H		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS**REFERENCES:**

1. Moore F., Environmental Control system Mc Graw 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, Mc Graw Hill, 1984.
4. J.R. Waters, Energy conservation in Buildings: A Guide to part L of the Building Regulations, Blackwell Publishing, 2003.

MCM 055	SHORING, SCAFFOLDING AND FORMWORK	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Concrete Technology				
	Course Designed by : Department of civil				
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)					
CO1	Study the materials associated with formwork.				

CO2	Study the design aspects of formwork under various requirements.					
CO3	Know the design of forms and shores.					
CO4	Study the planning and erection aspects of form work for buildings.					
CO5	Understand few other special types of forms.					
Mapping of Course Outcomes with 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	L			L	
	CO2	H	H		L	
	CO3	H	H			L
	CO4		M			
	CO5	M	L		L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-PLANNING AND SITE EQUIPMENT & PLANT FOR FORM WORK 9

At Tender stage – Development of basic system – Planning for maximum reuse – Economical form construction – Planning examples – Crane size, effective scheduling estimate – Recheck plan details – Detailing the forms. Overall Planning – detail planning – Standard units – Corner units – Schedule for column formwork – Formwork elements – Planning Crane arrangements – Site layout plan – Transporting plant – Formwork beams – Formwork ties – Wales and ties – scaffold frames from accessories – Vertical transport table form work.

UNIT II-FORM MATERIALS

9

Lumber – Types – Finish – Sheathing boards working stresses – Repetitive member stress – Plywood – Types and grades – Textured surfaces and strength – Reconstituted wood – Steel – Aluminium Form lining materials – Hardware and fasteners – Nails in Plywood Concrete density – Height of discharge – Temperature – Rates of Placing – Consistency of concrete – Live loads and wind pressure – Vibration Hydrostatic pressure and pressure distribution – Examples – Vertical loads - Uplift on shores – Adjustment for non standard conditions.

UNIT III-DESIGN OF FORMS AND SHORES

9

Basic simplification – Beam formulas – Allowable stresses – Deflection bending lateral stability – Shear, Bearing – Examples in wall forms – Slab forms – Beam forms – Ties, Anchors and Hangers – Column forms – Examples in each. Simple wood stresses – Slenderness ratio – Allowable load – Tubular steel shores patented shores – Site Preparation, Size and spacing – Steel Tower Frames – Safety practices – Horizontal shores shoring for multistories – More concentrated shore loads T- heads – Tow Tier wood shores – Ellis shores – Dayton sure grip and Baker Roofs shores – Safeway Symons shores – Beaver – advance shores Dead shore – Raking and Flying shores.

UNIT IV-FORMWORK FOR BUILDINGS

9

Location of job mill – Storage – Equipment – Footings – Wall footings – Column footings Sloped footing forms – Curb and gutter forms – Wall forms –Prefabricated panel systems – Giant forms curved wall forms – Column heads – Beam or girder forms – Beam pockets – Suspended forms – Concrete joint construction – Flying system forms. Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping – Errors in design – Failure to follow codes – How formwork affects concretes quality – ACI – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – Advantages of reshoring.

UNIT V-FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SAFETY PRACTICES FOR SCAFFOLDS

9

Hemispherical, Parabolic, Translational typical barrel vaults, Hyperbolic Folded plates – Shell form design considerations loads – Inserts , Anchors bolts – Building the forms-Placing concrete – Form removed – Strength requirements – Tunnel forming components – Curb forms invert forms – Arch forms – Concrete placement methods – Cut and cover construction – Tolerances – Form construction – Shafts. Slip Forms -Principles – Types – advantages – Functions of various components – Planning – Desirable characteristics of concrete – Common problems faced – Safety in slip forms special structures built with slip form Technique – Codal provisions Types of scaffolds – Putlog and independent scaffold – Single pole scaffolds – Fixing ties – Spacing of ties plan – bracing – knots – safety net – General safety requirements – precautions against particular hazards – Truss suspended – Gantry and system scaffolds.

TOTAL: 45 PERIODS

REFERENCES:

1. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, McGraw – Hill , 1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996
3. Michael P. Hurst, Construction Press, London & New York, 2003
4. Austin, C.K., Formwork for Concrete, Cleaver – Hume Press Ltd., London, 1996.

MCM 056	CONSTRUCTION PROJECT MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Construction Technology				
		Course Designed by : Department of civil				
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)						
CO1	Know the types and financing of construction and changing environment of the industry.					
CO2	Understand the organisation of project management.					
CO3	Know the design and construction process as an integrated system.					
CO4	Know the labour, material and equipment utilisation.					
CO5	Understand Cost Estimates and the Costs Associated with Construction Facilities.					
Mapping of Course Outcomes with 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			L	M
	CO2		M			L
	CO3			L		
	CO4		L			M
	CO5	L			M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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.

MCM 057	QUANTITATIVE TECHNIQUES IN MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Principles of Management				
		Course Designed by : Department of civil				
OBJECTIVES : To bring about an understanding of quantitative techniques in management and managerial economics.						
COURSE OUTCOMES (COs)						
CO1		Know the operations research and optimality analysis.				
CO2		Understand the production management.				
CO3		Understand the financial management.				
CO4		Know decision making under conditions of certainty, risk and uncertainty.				
CO5		Understand managerial economics and game theory 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		L	
	CO2		L		M	
	CO3		L		M	
	CO4	L			L	
	CO5	M				L
1	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-OPERATIONS RESEARCH

12

Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems.

UNIT II-PRODUCTION MANAGEMENT

12

Inventory Control - EOQ - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.

UNIT III-FINANCIAL MANAGEMENT

7

Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.

UNIT IV-DECISION THEORY

7

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

UNIT V-MANAGERIAL ECONOMICS

7

Cost Concepts – Break-even analysis – Pricing Techniques – Game theory Applications.

TOTAL: 45 PERIODS

REFERENCES:

1. Vohra, N.D., Quantitative Techniques in Management, Tata McGraw-Hill Company Ltd, New Delhi, 1990.
2. Schroeder, R.G, Operations Management, McGraw Hill, USA, 1982.
3. Levin, R.I, Rubin,D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill Book Co., 1988.
4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Mifflin Co., Boston, 1975.
5. Hamdy A.Taha, Operations Research: An Introduction, Prentice Hall, 2002.

MCM 058	CONSTRUCTION PERSONNEL MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Total Quality Management				
	Course Designed by : Department of civil				
OBJECTIVES : To introduce the elements of human behaviour and their impact on construction personnel management.					
COURSE OUTCOMES (COs)					
CO1	Know about the Manpower Planning and Organising.				
CO2	Understand the Development and Operation of human resources				
CO3	Understand the awareness on fundamentals of human behavior under varying stress conditions.				
CO4	Know the welfare measures and Laws related to welfare measures.				

CO5		Understand Management and Development Methods Productivity of Human resources.				
Mapping of Course Outcomes with 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	M	L		L	
	CO2	M	L		L	
	CO3					M
	CO4	L				L
	CO5	L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

10

TOTAL: 45 PERIODS

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 Gooderi Longenecter, Management, CE Merrill Publishing Co.1981.
5. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillan IndiaLtd.,2005.

MCM 059	BUSINESS ECONOMICS AND FINANCE		L	T	P	C
	MANAGEMENT					
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Management Concepts for civil engineers					
Course Designed by : Department of civil						
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)						
CO1	Know about the engineering economics and Quality Audit in economic law of returns governing production.					
CO2	Understand the Construction development in Housing, transport energy and other infrastructures.					
CO3	Know the financial control and the need of financial management.					
CO4	Know the Accounting for tax reporting purposes and financial reporting purposes.					
CO5	Understand the interim construction financing.					
Mapping of Course Outcomes with 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		M			L
	CO2	M	L		L	
	CO3	M			M	L
	CO4	L				
	CO5		M		L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS**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.

MCM 060		QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Total Quality Management						
		Course Designed by : Department of civil						
OBJECTIVES : To create a complete understanding on quality planning, quality assurance, quality control and safety management.								
COURSE OUTCOMES (COs)								
CO1		Know the Quality plan and Quality Management Guidelines.						
CO2		Understand the Quality system and standard Documents and Quality related training.						
CO3		Know the quality planning, Contract and construction programming, Inspection procedures, Processes and products						
CO4		Know the quality assurance, appraisals and quality control by reliability testing.						
CO5		Understand how the quality techniques can be improved.						
Mapping of Course Outcomes with 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	M	L		L			
	CO2	L				M		

	CO3	M			M	
	CO4	H	L		L	M
	CO5	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-QUALITY MANAGEMENT

9

Introduction – Definitions and objectives – Factor influencing construction quality - Responsibilities and authority - Quality plan - Quality Management Guidelines – Quality circles.

UNIT II-QUALITY SYSTEMS

9

Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

UNIT III-QUALITY PLANNING

9

Quality Policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi's concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.

UNIT IV-QUALITY ASSURANCE AND CONTROL

9

Objectives - Regularity agent, owner, design, contract and construction oriented objectives, methods - Techniques and needs of QA/QC - Different aspects of quality - Appraisals, Factors influencing construction quality - Critical, major failure aspects and failure mode analysis, - Stability methods and tools, optimum design - Reliability testing, reliability coefficient and reliability prediction.

UNIT V-QUALITY IMPROVEMENT TECHNIQUES

9

Selection of new materials -Influence of drawings, detailing, specification, standardization -Bid preparation -Construction activity, environmental safety, social and environmental factors - Natural causes and speed of construction -Life cycle costing -Value engineering and value analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. James, J.O' Brian, Construction Inspection Handbook – Quality Assurance and Quality Control, Van Nostrand, New York, 1989.
2. Kwaku, A., Tena, Jose, M. Guevara, Fundamentals of Construction Management and Organisation, Reston Publishing Co., Inc., Virginia, 1985.
3. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, Tata McGraw Hill, 1993
4. Hutchins.G, ISO 9000, Viva Books, New Delhi, 2000
5. Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw-Hill, 1989.
6. John L. Ashford, The Management of Quality in Construction, E & F.N.Spon, New York, 1989.
7. Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, England. 1998.

MCM 061		RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Building construction						
		Course Designed by : Department of civil						
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)								
CO1		Know the Resource Planning, Procurement and Identification.						
CO2		Understand the Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.						
CO3		Study and evaluate the resources - material, equipment, labour and time.						
CO4		Know to manage time on the project and forecasting the future.						
CO5		Understand other concepts regarding resource allocation and levelling.						
Mapping of Course Outcomes with 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	M	L		M	L		

	CO2	H	M		L	L
	CO3	M	L		M	
	CO4		M			L
	CO5	H	M		L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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, Osborne- McGraw Hill C.A.Publishing Co., Inc. 1988.
4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1980.

MCM 062		PROJECT SAFETY MANAGEMENT			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Building construction						
		Course Designed by : Department of civil						
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)								
CO1		Know the nature of construction accidents and their causes.						
CO2		Understand the Elements of an Effective Safety Programme.						
CO3		Know the Safety in Construction Contracts, Substance Abuse and Safety Record keeping.						
CO4		Know the Safety Culture and Project Coordination and Safety Procedures.						
CO5		Understand other concepts regarding safety sampling and audit.						
Mapping of Course Outcomes with 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	M	H		L			
	CO2		M			L		
	CO3	M	H		L			
	CO4		M			L		
	CO5	M	H		L			

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

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.

TOTAL: 45 PERIODS

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.

MCM 063		MANAGEMENT INFORMATION SYSTEM			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Management concepts for civil engineers						
		Course Designed by : Department of civil						
OBJECTIVES : To study the various models of management information systems and their application to project management.								
COURSE OUTCOMES (COs)								
CO1		Know the exposure to information systems in a formal manner.						
CO2		Understand the development of information systems.						
CO3		Know the means of applying information systems models to project management.						
CO4		Know to assess the value and risk of Information System.						
CO5		Understand other concepts regarding system audit and its associated features.						
Mapping of Course Outcomes with 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				L		
	CO2	H	M		L			
	CO3		L					
	CO4	L				M		
	CO5	M	L		L			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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.

TOTAL: 45 PERIODS**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, Structure and 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 Marciniak, Software Quality assurance and Management, John Wiley and Sons, 1987.
6. Card and Glass, Measuring Software Design quality , Prentice Hall, 1990.

MCM 064	ENERGY-EFFICIENT BUILDINGS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Environmental studies				
	Course Designed by : Department of civil				

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)						
CO1		Know the energy requirement of the building construction.				
CO2		Understand the key design principles for energy efficient buildings				
CO3		Know the concepts of day lighting and components of daylight factor.				
CO4		Know the Heat transmission, heat control and ventilation.				
CO5		Know about the Energy efficient buildings for various zones.				
Mapping of Course Outcomes with 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	L	M		L	
	CO2		M		L	H
	CO3	M			M	M
	CO4		L		L	
	CO5	M	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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.

MCM 065	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Construction Technology				

		Course Designed by : Department of civil				
OBJECTIVES : To study the damages, repair and rehabilitation of structures.						
COURSE OUTCOMES (COs)						
CO1		Know about maintenance and repair strategies.				
CO2		Know about serviceability and durability of concrete.				
CO3		Know the materials and techniques for repair.				
CO4		Know the stabilization techniques for repair.				
CO5		Understand the engineered demolition techniques for 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
2	CO1	M			L	L
	CO2	M			L	L
	CO3	M				L
	CO4	M			L	L
	CO5	M			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-MAINTENANCE AND REPAIR STRATEGIES

8

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II-SERVICEABILITY AND DURABILITY OF CONCRETE

8

Quality assurance for concrete construction concrete properties - strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking.

UNIT III-MATERIALS AND TECHNIQUES FOR REPAIR**15**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection.

UNIT IV-REPAIRS TO STRUCTURES**10**

Repair of structures distressed due to earthquake – Strengthening using FRP Strengthening and stabilization techniques for repair.

UNIT V-DEMOLITION OF STRUCTURES**4**

Engineered demolition techniques for structures - case studies.

TOTAL: 45 PERIODS**REFERENCES:**

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.
3. Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" - R&D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
4. Santhakumar A.R., "Concrete Technology" Oxford University Press, Printed in India by Radha Press, New Delhi, 2007.
5. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.

MCM 066	CONDITION ASSESSMENT AND EVALUATION	L	T	P	C
	ENGINEERING				
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Repair and rehabilitation of structures				
	Course Designed by : Department of civil				
OBJECTIVES : To bring about an understanding of use of methods, techniques and equipments for condition assessment and evaluation engineering.					
COURSE OUTCOMES (COs)					
CO1	Know the Procedure for the condition assessment of concrete structures.				
CO2	Understand the working of NDT equipments.				
CO3	Know the electro-chemical methods performed.				

CO4	Know the chemical analysis for cement content.					
CO5	Understand other concepts regarding performance and integrity tests.					
Mapping of Course Outcomes with 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	M	L		L	
	CO2		M			
	CO3		M		L	
	CO4		M		M	
	CO5		M			L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS**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.

MCM 067	PREFABRICATION AND CONSTRUCTION			L	T	P	C
	TECHNIQUES						
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Pre stressed concrete structures						
Course Designed by : Department of civil							
OBJECTIVES : To bring about an understanding of the prefabrication and construction techniques adopted.							
COURSE OUTCOMES (COs)							
CO1	Know the standardization and tolerances-system for prefabrication.						
CO2	Understand the Pre-casting and handling techniques.						
CO3	Know the Curing techniques including accelerated curing.						
CO4	Know the Pre-cast and pre-fabricating technology for low cost and mass housing schemes.						
CO5	Understand the Repairs and economical aspects on prefabrication.						
Mapping of Course Outcomes with 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		L		M		

	CO2	M	L		L	L
	CO3		M			
	CO4	M	M			L
	CO5	M			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS

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. Madhava Rao.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., Balkema Publishers, Netherland, 1991.

MCM 068		DESIGN OF INDUSTRIAL STRUCTURES			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Industrial structures						
		Course Designed by : Department of civil						
OBJECTIVES : To bring about an understanding of the design of Industrial structures and construction techniques for Industrial Structures.								
COURSE OUTCOMES (COs)								
CO1		Know the Specific requirements for industries.						
CO2		Understand the Planning of building work of industrial structures.						
CO3		Know the use of modern hoisting and other construction equipments.						
CO4		Know the working of lifts, cranes, continuous conveyors.						
CO5		Understand the Functional requirements of industrial 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		
2	CO1	L	M		L			
	CO2		H		M			
	CO3	M				L		
	CO4	L	M		L			
	CO5	M			L			

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

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.

TOTAL: 45 PERIODS

REFERENCES

1. Dunham, C.W ,Planning of industrial structures-Mc Graw 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

MCM 069	GIS IN CONSTRUCTION ENGINEERING AND MANAGEMENT			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Geographic and information system						
	Course Designed by : Department of civil						
OBJECTIVES : To introduce the elements of GIS as applied to construction management and achieve awareness on application techniques.							
COURSE OUTCOMES (COs)							
CO1	Know the characteristics of map and map projections.						
CO2	Understand the the various types of data, data analysis methods and data quality requirements.						
CO3	Know the concepts of raster and vector data structure and applications of DEM.						
CO4	Know the Measurement, Buffering, Overlaying and Components of data quality.						
CO5	Understand means of getting suitable data output and to use the data output for construction management using GIS 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	
2	CO1	M			L		
	CO2	M	L				
	CO3	M			L	L	
	CO4	M			L	L	
	CO5	M	H			M	

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

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

TOTAL: 45 PERIODS

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

MCM 070		INFRASTRUCTURE DEVELOPMENT			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Building Construction						
		Course Designed by : Department of civil						
OBJECTIVES : To bring about an understanding of the infrastructure development, status of infrastructure in India and the agencies associated with it.								
COURSE OUTCOMES (COs)								
CO1		Know the Role of infrastructure development in employment generation.						
CO2		Know the Agencies associated with infrastructure development in India.						
CO3		Know the status of Infrastructure in India.						
CO4		Know the issues related to infrastructure development.						
CO5		Understand the funding and managing of infrastructure projects.						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	M				L		
	CO2		L		M	L		
	CO3				M	L		
	CO4				H	L		
	CO5				M	L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				✓				

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

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, responsibility of project management consultants.

TOTAL: 45 PERIODS

REFERENCES

1. India Infrastructure Report – Rakesh Mohan
2. Infrastructure Today - Magazine
3. Document of five year plans, published by Govt. of India.

MCM 071	BUILDING SERVICES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Building Construction				
	Course Designed by : Department of civil				
OBJECTIVES : To study the elements of building services like water supply sanitation, electrical installations air conditioning, and fire safety.					
COURSE OUTCOMES (COs)					

CO1	Know the components of water supply and sanitation arrangements in a building.					
CO2	Understand the the rudiments of electrical installations in a building.					
CO3	Know the ventilation and design principles of lifts and staircases for vertical mobility inside buildings.					
CO4	Know the safety regulations to be adopted in the building.					
CO5	Know the concepts of intelligent building.					
Mapping of Course Outcomes with 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	L	M			
	CO2		H			L
	CO3	L	H			
	CO4				H	M
	CO5	H			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL: 45 PERIODS**REFERANCES**

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 and Faber, 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*”, Callendar JH, 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.

MCM 072	RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Professional Courses				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					
- To Get adequate knowledge about research concepts - To describe mathematical modeling and simulation - To understand experimental modeling - To get knowledge about the interpretation of result					
COURSE OUTCOMES (COs)					
CO1	To describe research concepts.				

CO2	To Get adequate knowledge about mathematical modeling					
CO3	To describe experimental modeling					
CO4	To understand analysis of results					
CO5	To know about report writing					
Mapping of Course Outcomes with 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	M	L	M	M
	CO2	H	M	L	M	M
	CO3	H	M		M	M
	CO4	H	M	L	M	M
	CO5	H	M		M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I-RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT II-MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT III-EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT IV-ANALYSIS OF RESULT

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT V-REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CURRICULUM & SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM
M.Tech-STRUCTURAL ENGINEERING
FULL TIME
I – IV SEMESTERS

SEMESTER-I							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1	PM	MMA110	Advanced Mathematical Methods	3	2	0	4
2	PC	MST101	Theory of Elasticity and Plasticity	3	0	0	3
3	PC	MST102	Computer Aided Structural Analysis	3	0	2	4
4	PC	MST103	Structural Dynamics	3	0	0	3
5	PE	MST1E1	Professional Elective- I	3	0	0	3
6	PE	MST1E2	Professional Elective- II	3	0	0	3
			Total	18	2	2	20

SEMESTER-II							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1	PC	MST201	Concrete Structures	3	0	0	3
2	PC	MST202	Experimental Techniques and Instrumentation	3	1	0	3
3	PC	MST203	Finite Element Analysis	3	0	0	3
4	PC	MST204	Steel Structures	3	0	0	3
5	PC	MST205	Earthquake Resistant Design of Structures	3	0	0	3
6	PE	MST2E3	Professional Elective- III	3	0	0	3
Practical							
7	P L	MST2L1	Advanced Structural Engineering Laboratory	0	0	4	2
			Total	18	1	4	20

SEMESTER-III							
S.No	Category	Code	Subject Name	L	T	P	C
1	PE	MST3E4	Professional Elective- IV	3	0	0	3
2	PE	MST3E5	Professional Elective- V	3	0	0	3
3	OE	MST3E6	Open Elective	3	0	0	3
4	PW	MST3P1	Project Work Phase I	0	0	12	6
			Total	9	0	12	15

SEMESTER- IV							
S.No	Category	Code	Subject Name	L	T	P	C
1	PW	MST4P1	Project Work Phase II	0	0	24	12
			Total	0	0	24	12

Overall Credits for the Programme – 67

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)	4	-	-	-	4	4.5
2	Professional Core (PC)	10	17	-	-	27	40.9
3	Professional Electives (PE)	6	3	6	-	15	23
5	Open Electives (OE)	-	-	3	-	3	4.5
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	6	12	18	27
	Total Credits	20	20	15	12	67	100
	Total Contact Hours	22	23	21	24	89 Hrs	

LIST OF ELECTIVES

Professional Electives (PE-I)

S.No	Code	Subject Name	L	T	P	C
1	MST051	Computer Aided Structural Design	3	0	0	3
2	MST055	Design of Structures For Dynamic Loads	3	0	0	3
3	MST058	Industrial Structures	3	0	0	3
4	MST062	Optimization in Structural Design	3	0	0	3

Professional Electives (PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
5	MST053	Design of Bridges	3	0	0	3
6	MST056	Design of Tall Buildings	3	0	0	3
7	MST061	Offshore Structures	3	0	0	3

Professional Electives (PE-III)

8	MST054	Design of Foundation Structures	3	0	0	3
9	MST065	Stability of Structures	3	0	0	3

Professional Electives (PE-IV)

10	MST064	Pre-stressed Concrete	3	0	0	3
11	MST052	Advanced Concrete Technology	3	0	0	3
12	MST060	Maintenance and Rehabilitation of Structures	3	0	0	3
13	MST063	Prefabricated Structures	3	0	0	3

Professional Electives (PE-V)

14	MST066	Theory of Plates	3	0	0	3
15	MST067	Wind and Cyclone Effects On Structures	3	0	0	3
16	MST068	Design of Shell and Spatial Structures	3	0	0	3
17	MST069	Disaster Resistant Structures	3	0	0	3

List of Open Elective (OE)

	Code No.	Course Title	L	T	P	C
18	MST070	Research Methodology	3	0	0	3
19	MST057	Environmental Engineering Structures	3	0	0	3

SYLLABUS

MMA110		ADVANCED MATHEMATICAL METHODS				L	T	P	C
		Total Contact Hours:75				3	2	0	4
		Prerequisite: Numerical Methods							
		Course Designed by :Department of civil							
OBJECTIVES To familiarize the students in the field of differential equations to solve bound value problems associated with engineering applications.									
COURSE OUTCOMES (COs)									
CO1		To make them master the techniques of Partial Differential Equations							
CO2		To know about Fourier Transform Techniques							
CO3		To understand about Concept of variation and its properties							
CO4		To know about the Conformal Mapping and Applications							
CO5		To know about Tensor 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				W			
	CO2	H	L	M					
	CO3	H							
	CO4	H		M		W			
	CO5	H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
		√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9+6

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+6

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 Poisson's equations.

UNIT III CALCULUS OF VARIATIONS 9+6

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 CONFORMAL MAPPING AND APPLICATIONS 9+6

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS 9+6

Summation convention – Contravariant and co-variant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient, divergence and curl.

REFERENCES:

1. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
2. James,G., "Advanced Modern Engineering Mathematics, 3rd Edition, Pearson Education, 2004.
3. Ramaniah.G. "Tensor Analysis", S.Viswanathan Pvt. Ltd., 1990.
4. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
5. Spiegel, M.R., "Theory and Problems of Complex Variables and its Application (Schaum's Outline Series)", McGraw Hill Book Co., 1981.

MST 101	THEORY OF ELASTICITY AND PLASTICITY				
	Total Contact Hours:45				
	L	T	P	C	
	3	0	0	0	3
Prerequisite: strength of materials					
Course Designed by : Department of civil Engineering					
OBJECTIVES To understand the concept of 3D stress, strain analysis and its application simple problems					
COURSE OUTCOMES (COs)					
CO1	To know about the Basic Concepts of deformation of elastic bodies.				
CO2	To understand the concepts of Equations of equilibrium and Compatibility.				
CO3	To know about the Torsion methods of analysis.				
CO4	To study the concepts of theorem of minimum potential energy				

CO5		To get knowledge about introduction to plasticity.				
Mapping of Course Outcomes with 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				
	CO2	H			L	
	CO3	H	L			
	CO4	H				L
	CO5	H				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION

9

Basic Concepts of deformation of elastic bodies – Notation for stress and strain transformation of strain components Theory of small displacement – Generalized Hook's Law – Significance of elastic constant for isotropic materials –Plane stress and Plane strain problems.

UNIT-II STRESS STRAIN ANALYSIS

9

Two dimensional problems in rectangular coordinates, Equations of equilibrium and Compatibility –analysis of stress and strain in three dimensions –Simple problems

UNIT-III TORSION

9

Torsion of non – circular section, methods of analysis –membrane analogy –torsion of thin rectangular section and hollow thin walled section

UNIT-IV ENERGY METHODS

9

Energy methods – theorem of minimum potential energy – energy theorem- Rayleigh Ritz methods.

UNIT-V PLASTICITY

9

Introduction to plasticity – Physical assumptions, yield criteria of metal flow, Laws of Plastic mass – Plastic stress strain relationship –Lower and Upper Bound theorem. Applications to simple problems in tension and compression.

Tutorials

15

L=45, T=15, No. of Periods: 45

References:

1. Timoshenko .S. and Goodier .J.N. "Theory of Elasticity", McGraw Hill Book Co., New York 1988.

2. Sadusingh ,” Theory of elasticity ,” Khanna Publisher,1988.
3. SaduSingh, “Theory of Elasticity , “Khanna Publisher,1988
4. N.Krishna,Raju,Guru,Raja ”Advanced Mechanics of wilds and structures, “Narosa Publishing House”
5. V.K. Manickaselvam “ Fundamentals of limit Analysis of structures” Dhanpat Rai& Sons,Delhi.

MST 102		COMPUTER AIDED STRUCTURAL ANALYSIS			L	T	P	C
		Total Contact Hours:30			3	0	2	4
		Prerequisite: computer aided structural design						
		Course Designed by :Department of civil Engineering						
OBJECTIVES To introduce the students about computer applications, structural analysis, design of special structures and expert systems with application analysis.								
COURSE OUTCOMES (COs)								
CO1		To make them master the Analysis of pin jointed and rigid jointed plane frames.						
CO2		To know about Displacement Method						
CO3		To understand about Application to Plane – trusses & Plane frames						
CO4		To know about the Computer applications and use of computer packages.						
CO5		To analyse problems based on large 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		
2	CO1	H		H	M	L		
	CO2	H		H				
	CO3	H		H		L		
	CO4	H		H	M			
	CO5	H		H		L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Introduction to Matrix methods – Displacements formulation – Co-ordinate transformations, Analysis of pin jointed and rigid jointed plane frames – Continuous beams.

UNIT-II DISPLACEMENT METHOD -3D ANALYSIS 9

Displacement method – three dimensional structures – Coordinate transformation – analysis of space trusses and rigid jointed space frames

UNIT-III FORCE METHOD 9

Matrix Force method – general formulation –Application to Plane – trusses & Plane frames

UNIT-IV COMPUTER APPLICATION 9

Computer applications and use of computer packages – Staad Pro-Strap analysis – sap 2000 Gtstcul – Programming Techniques – Problems.

UNIT-V SPECIAL PROBLEMS 6

Analysis of large structures – substructures – subs structuring – static condensation procedure – Simple problems.

Practicals 30

Total No. of Periods: 45 + 30

Text book:

1. M.Rubeinstein “ Matrix analysis of structures”

References:

1. John I Meek matrix “ Structural analysis “ –M.C Graw Hill Book –Co
2. Coastos R.C.CoutieM.G.and Kong F.K.” Structural Analysis “John Wiley and Sons.
3. McGuire W and Gallagher,R.H. JohnWilly and Sons Matrix structural Analysis.

MST 103	STRUCTURAL DYNAMICS	L	T	P	C
	Total Contact Hours:60	3	0	0	3
	Prerequisite: Basics of dynamics and asesmic design				
	Course Designed by :Department of civil Engineering				
OBJECTIVES To introduce the students about computer applications, structural analysis, design special structures and expert systems with application analysis.					
COURSE OUTCOMES (COs)					
CO1	To learn about Principles of dynamics and application to seismic instruments				
CO2	To know about two and multiple degree freedom system				
CO3	To understand about natural frequencies and modes shapes.				
CO4	To know about the Computer applications and use of computer packages.				

CO5		To analyze problems based on application to earthquake resistant 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
2	CO1	H	M	L		
	CO2	H		L		
	CO3	H			M	L
	CO4	H	M			
	CO5	H				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION

12

Principles of Dynamics - D'Alembert's Principle - 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 & orthogonality 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 STRUCTURES

8

Application to Earthquake Resistant Design with particular Reference to Buildings Provisions of IS 1893

Tutorials

15

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.

MST 201		CONCRETE STRUCTURES				L	T	P	C
		Total Contact Hours:45				3	0	0	3
		Prerequisite: Reinforced Concrete Structures - I							
		Course Designed by :Department of civil Engineering							
OBJECTIVES. To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.									
COURSE OUTCOMES (COs)									
CO1		To learn about calculation of deflection and crack width according to IS 456-2000							
CO2		To know about design of special RC elements.							
CO3		To Design flat slabs and flat plates according to ACI method.							
CO4		To know about the inelastic behavior of concrete beams.							
CO5		To analyze problems based on detailing for ductility.							
Mapping of Course Outcomes with 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	M						
	CO2	H		H					
	CO3	H	M		L	L			
	CO4	H							
	CO5	H	M						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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.

Total No. of Periods: 45

References:

1. Purushothaman P, Reinforced Concrete Structural Elements: Behaviour Analysis and Design, Tata McGraw Hill, 1986.
2. Varghese P. C., Limit State Design of Reinforced Concrete, Prentic Hall of India, 1995.
3. Krishna Raju, N. Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 1986.
4. N. C. Sinha, S. K. Roy, Fundamentals of Reinforced concrete, S. Chand&Company Ltd, 2001.
5. Varghese. P. C. Advanced Reinforced concrete design, Prentice Hall of India, 2005.

MST202		EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION			L	T	P	C
		Total Contact Hours: 45			3	1	0	3
		Prerequisite: Numerical Theory of Elasticity and Plasticity						
		Course Designed by :Department of civil						
OBJECTIVES To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.								
COURSE OUTCOMES (COs)								
CO1		To learn Introduction about Basic concepts in stress and strain						
CO2		To know about design of special RC elements						
CO3		To understand the various measurement techniques.						
CO4		To know about the applied measurements and displacement measurements						
CO5		To analyze advanced measuring techniques						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		

2	CO1	H	M			
	CO2	H			L	
	CO3	H	M			L
	CO4	H		M	L	
	CO5	H		M		L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

PART-A

EXPERIMENTAL STRESS ANALYSIS (ESA)

UNIT – I INTRODUCTION 5

Basic concepts in stress and strain, two dimensional, three dimensional and plane stress problems – stress analysis using equilibrium equations and load relaxation Techniques.

UNIT-II MEASUREMENT TECHNIQUES 10

Strain measurement using mechanical, optical and electrical gauges for static and dynamic stress analysis. Whole field methods, Photoelasticity, stress optic law, plane and circular polariscope, isoclinics, isochromatics, compensation methods of separation of stresses.

PART-B INSTRUMENTATION

UNIT-III MEASURING INSTRUMENTS 5

Basic characteristics and dynamic response measuring instruments, sensing elements, transducer. Measuring & transmission methods, Indicating and recording means.

UNIT-IV DISPLACEMENT MEASUREMENT TECHNIQUES 5

Applied measurements, displacement measurements, measurement of force and torque, load cells, cantilever beams and torque tubes.

UNIT-V ADVANCED MEASURING TECHNIQUES 5

Stress strain measurements and strain bridges, measurements of temperature and pressure, electronic measuring instruments, oscillographs and oscilloscopes, sonic and ultra sonic testers, data loggers, micro-processors, selection and use.

Practical 30

Total No of Periods: 30 + 30 = 60

Text books:

1. ESA by James W.Dally & William F.Ricley

2. Instrumentation, Devices and Systems C.Rangan, G.R. Sanma, V.S.V. mani.

References:

1. ESA & Motion measurements: Dove R.L. & Adams P.H
2. Engineering measurement in instrument LF. Adams.
3. Experimental methods for Engineers; J.P. Holman.
4. Instrumentation for engineering: Dally & Riley.
5. ESA: Sadhu Singh.

MST203		FINITE ELEMENT ANALYSIS				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Structural Analysis-I							
		Course Designed by :Department of civil							
OBJECTIVES To study the energy principles, finite element concept, stress analysis, meshing, linear problems and applications.									
COURSE OUTCOMES (COs)									
CO1		To learn concepts of piecewise Approximation and Finite Elements							
CO2		To know about two dimensional problems in stress analysis							
CO3		To understand the meshing and solution problems.							
CO4		To know about the nonlinear and vibration problems							
CO5		To understand the Application to Thermal Analysis 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			
2	CO1	H	L						
	CO2	H		H					
	CO3	H	L		L				
	CO4	H				L			
	CO5	H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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 Axisymmetric 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.

Total No. of Periods: 45**References :**

1. Bathe, K.J. Finite Elements Procedures in Engineering analysis. Prentice Hall Inc., 1995.
2. Zienkiewicz, 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.

MST203	STEEL STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Design of steel structures				
	Course Designed by :Department of civil				
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)					
CO1	To learn design of members subjected to lateral loads and axial loads				
CO2	To know about design of various types of Connections				
CO3	To understand the analysis and design of steel towers.				
CO4	To know about the plastic analysis of structures				

CO5		To analyze and solve problems on design of light gauge steel 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
2	CO1	H	H			
	CO2	H				L
	CO3	H		L	M	
	CO4	H				
	CO5	H				M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I 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.

Total No. of Periods:45

Text book:

1. Dayarathnam.P , Design of Steel Structures, A.H. Wheeler, 1990.

REFERENCES:

1. Home, M.R., and Monies, L.J, Plastic Design of Low-rise frames, Granada Publishing Ltd., 1981.
2. Salmo C.G., and Johnson J.E., Steel Structure- Design and Behaviour, harper and Row, 1980.
3. Kuzamanovic, B.O. and Williams, N., Steel Design for Structural Engineer, Prentice Hall, 1977.
4. Wie – Wen Yu., Cold – Formed Steel Structures, McGraw Hill Book Company, 1973.
5. William McGuire, Steel Structures, Prentice Hall, Inc., Englewood Cliffs, N.J. 1986

MST205		EARTHQUAKE RESISTANT DESIGN OF STRUCTURES				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Basic Dynamics and Aseismic design							
		Course Designed by :Department of civil							
OBJECTIVES To study the effects of earthquakes analysis and design of earthquake resistant structures									
COURSE OUTCOMES (COs)									
CO1		To learn elements of engineering seismology							
CO2		To know about seismic design concepts							
CO3		To understand the response of structural elements to the dynamic loads.							
CO4		To know about the Indian Standard Codes Of Practice							
CO5		To understand modern concepts.							
Mapping of Course Outcomes with 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							
	CO2	H	M						
	CO3	H							
	CO4	H							
	CO5	H	M						

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

UNIT-I ELEMENTS OF ENGINEERING SEISMOLOGY 8

Definitions of magnitude, intensity, epicenter, focus – general features of tectonics of seismic regions in India – seismographs – nature of dynamic loading resulting from Earthquakes.

UNIT-II SEISMIC DESIGN CONCEPTS 12

Review of Theory of Structural vibrations induced under base excitation- Single degree & multiple degree idealizations – Response spectrum approach – Time History Analysis – Building systems with frames, with and without shear walls.

UNIT-III PERFORMANCE OF STRUCTURES 10

Response of Structural elements to the dynamic loads. Ductility and energy absorption – Regular and irregular building types.

UNIT-IV INDIAN STANDARD CODES OF PRACTICE 10

Provisions of Indian standard code IS 1893. Approach to Aseismic analysis of miscellaneous structures such as retaining walls, water tanks, and dams. Importance of detailing IS4326.

UNIT-V MODERN CONCEPTS 5

Base Isolation techniques – Active & Passive control – Case Studies.

Total No. of Periods = 45

References:

1. Jaikrishna & Chandra Sekharan: "Elements of Earthquake Engineering"
2. Chopra.A.K, "Structural Dynamics & Earthquake Engineering" Prentice Hall, N.J., 1995.
3. Dowrick, D.J "Earthquake Resistant Design" John Wiley & Sons, London.
4. Arnold C & Reitharman.R "Building Configuration & Seismic Design"
5. Wiegel, R.I (Ed): "Earthquake Engineering" Prentice Hall, N.J., 1977.

MST2L1	ADVANCED STRUCTURAL ENGINEERING LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Concrete and Highway lab				
	Course Designed by :Department of civil				
OBJECTIVES To provide exposure to the students with hands on experience in advanced structural engineering lab					

COURSE OUTCOMES (COs)						
CO1	To provide hands on exercises in common concrete mix design by IS Code and other methods					
CO2	To expose the students regarding strain measurement using mechanical and electrical strain gauges					
CO3	To provide hands on exercise flexural behavior of reinforced concrete beams					
CO4	To provide exposure regarding structural behavior of columns					
CO5	To expose the students regarding non-destructive tests on concrete.					
Mapping of Course Outcomes with 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			
	CO2		M			
	CO3		H			
	CO4		H			
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

MST051		COMPUTER AIDED STRUCTURAL DESIGN			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Computer Aided Structural Analysis						
		Course Designed by :Department of civil						
OBJECTIVES To study the effects of earthquakes analysis and design of earthquake resistant structures								
COURSE OUTCOMES (COs)								
CO1		To learn drafting software packages and usage						
CO2		To know about Computer methods of structural analysis						
CO3		To understand the response of structural elements to the dynamic loads.						
CO4		To know about the computer aided design of steel and RC structural elements						
CO5		To understand knowledge based expert 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					
	CO2		M					
	CO3		H					
	CO4		H					
	CO5		M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

1	COs/Pos	a	b	c	d	e
2	CO1		H			
	CO2		M			
	CO3		H			
	CO4		H			
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CONCRETE MAKING MATERIALS 9

Aggregates, IS Specifications, Properties, Grading, Methods of combining aggregates, specified grading. Cement, Grades of cement. Chemical composition, Hydration of cement, structure of hydrated cement, Special cements - Water Chemical admixtures. Mineral admixtures.

UNIT II CONCRETE 9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage. Variability of concrete strength. Concrete testing Methods: Non destructive tests ultrasonic pulse velocity, Rebound Hammer test. Pullout tests.

UNIT III MIX DESIGN 9

Principles of concrete mix design. Methods of concrete mix design. Indian standard Recommended Method. IS 10262-82

UNIT IV SPECIAL CONCRETE 9

Light Weight concrete, Fly ash concrete, Fibre reinforced concrete, Polymer Concrete, Super plasticised concrete, Epoxy resins and screeds for rehabilitation - Properties and Applications-High performance concrete.

UNIT-V CONCRETING METHODS 9

Process of manufacturing of concrete, methods of transportation, placing and curing - Extreme weather concreting, special concreting methods. Vacuum dewatering underwatering concrete, ready mix concentrate.

Total No. of periods: 45

References:

1. Neville, A.M. Properties of Concrete, Pitman Publishing Limited, Lnclon.
2. Shetty M.S., Concrete Technology, S. Chand and Company Ltd. Delhi.
3. RudhaniG., Light Weight Concrete Academic Kiado, Publishing Home of Hungarian Academy of Science, 1963.

MST053		DESIGN OF BRIDGES				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Prestressed Concrete Structures							
		Course Designed by :Department of civil							
OBJECTIVES To study the loads, forces on bridges and design of several types of bridges									
COURSE OUTCOMES (COs)									
CO1		To learn about introduction and investigation for bridges							
CO2		To know about load distribution theories, analysis and design							
CO3		To understand the principles and methods of concrete mix design.							
CO4		To know about the various long span bridges							
CO5		To understand process carried out in bearings and substructure.							
Mapping of Course Outcomes with 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						
	CO2		M						
	CO3		H						
	CO4		H						
	CO5		M						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I- INTRODUCTION AND INVESTIGATION FOR BRIDGES

9

Components of bridge - Classification - Need for investigation - Bridge site - Data collection - design discharge - linear waterway - economical span - scour depth - traffic projection - choice of bridge type.

UNIT II LOADS ON BRIDGES

9

Indian Road Congress (IRC) Bridge codes dimensions – dead and live loads - impact effect - wind and seismic forces - longitudinal and centrifugal forces - hydraulic forces - earth pressure - temperature effect and secondary stresses.

UNIT III SLAB AND T - BEAM BRIDGES

9

Design of slab bridges - skew slab culverts - box culverts. T - beam bridges - Pigeaud curves - Courbon's theory - Hendry Jaeger method - analysis and design of T - beam bridges.

UNIT IV LONG SPAN BRIDGES

9

Hollow girder bridges - balanced cantilever bridges - continuous girder bridges - rigid frame bridges - arch bridges - bow string girder bridges. Pre-stressed concrete bridges - composite pre-stressed concrete super structures - erection of precast girders - continuous construction - recent trends.

UNIT V BEARINGS AND SUBSTRUCTURE

9

Design of bearings for slab, girder, skew bridges - Design of piers - abutments - trestles, Joints - expansion joints.

Total No. of Periods: 45

References:

1. Raina VK. "Concrete Bridges Practice" Tata McGraw Hill publishing Company, New/Delhi, 1991.
2. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1998.
3. Dakht, B. and Jaegar, LG., Bridge Analysis simplified, McGraw Hill, 1985.
4. Ponnuswamy, S., Bridge Engineering, Tata McGraw Hill, 1989.
5. Derrick Beckett, An introduction to Structural Design of Concrete Bridges, Surrey University Press, Henley Thomes, Oxford Shire, 1973.
6. Taylor, F W, Thomson, S.E. and Smulski E., Reinforced Concrete Bridges, John wiley and Sons, New York, 1955.
7. Edwin H. GaylordJr., Charles N. Gaylord, James, E. Stallmeyer "Design of Steel Structures" McGraw Hill International Editions, 1992.

MST054		DESIGN OF FOUNDATION STRUCTURES		L	T	P	C
		Total Contact Hours: 45		3	0	0	3
		Prerequisite: Foundation Engineering					
		Course Designed by :Department of civil					
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)							
CO1		To learn about soil investigation and basic requirements of foundation					
CO2		To know about types of pile foundations and structural design					
CO3		To understand the types and design of well foundation.					
CO4		To know about the design of foundation for reciprocating and impact machines					
CO5		To understand process of special foundations on expansive soils.					
Mapping of Course Outcomes with 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				

	CO2		M			
	CO3		H			
	CO4		H			
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 retaining walls.

Total No. of Periods: 45

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.

MST055		DESIGN OF STRUCTURES FOR DYNAMIC LOADS			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Basic Dynamics and Aseismic design						
		Course Designed by :Department of civil						
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)								
CO1		To learn about factors affecting design against dynamic load						
CO2		To know about design against earthquakes as per BIS codes of practice						
CO3		To understand the design against blast and impact as per BIS codes.						
CO4		To know about the design of basic wind speeds						
CO5		To understand special considerations in detailing for ductility.						
Mapping of Course Outcomes with 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					
	CO2		M					
	CO3		H					
	CO4		H					
	CO5		M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I ENGINEERING SEISMOLOGY

10

Factors affecting design against dynamic load-Behaviors of concrete, steel, masonry and soil under impact and cyclic loads- recaps of structural dynamics with reference to SDOF, MDOF and continuous system - ductility and its importance.

UNIT II INTRODUCTION TO EARTHQUAKE ANALYSIS

10

Earthquakes characterization- response spectra-seismic coefficient and response spectra methods of estimating loads-response of framed, braced frames and shear wall buildings-design as per BIS codes of practices ductility based design.

UNIT-III FUNDAMENTALS OF SEISMIC PLANNING:

10

Characteristics of internal and external blast- impact and impulse loads-pressure distribution of building above ground due to external blast .Underground explosion design of buildings for blast and impact as per BIS codes of practice

UNIT-IV DESIGN APPROACHES:

10

Characteristics of wind – basic and design wind speeds-effect of permeability of the structures – pressure coefficient- aero elastic and aerodynamics effect-design as per BIS code of practice including gust factor approach –tall buildings, stacks and chimneys.

UNIT-V EARTHQUAKE – RESISTANT DESIGN OF STRUCTURAL COMPONENTS AND SYSTEMS:

5

Energy absorption capacity- ductility of the material and the structure-detailing for ductility-passive and active control of vibrations –new and favorable materials.

Total No. of Periods = 45

References:

1. Bela Goschy, design of building to with stand abnormal loading Butterworths 1990.
2. Paulay ,T and Priestly, M.N.J.A seismic design of reinforced concrete and masonry building, John Wiley and Sons 1991.
3. Cowling .C.H.Blast vibration – monitoring and control, Prentice Hall Inc. Eaglewood Cliffs,1985.
4. Kolousek,V.et al.. Wind effects on Civil Engineering Structures, Elsevier, 1984.
5. Concrete Structures under impact and Impulsive Loading, Synthesis Report CEB, Lousanne, Germany, 1988.

MST056	DESIGN OF TALL BUILDINGS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Dynamics and Aseismic design				
	Course Designed by :Department of civil				
OBJECTIVES To study the behavior, analysis and design of tall structures.					
COURSE OUTCOMES (COs)					
CO1	To learn about design criteria based on materials and sequential loading				
CO2	To know about earthquake loading, model analysis and combinations of loading				
CO3	To understand the behavior of various structural systems				
CO4	To know about the Modeling for approximate analysis, Accurate analysis and reduction techniques.				
CO5	To understand special considerations in stability of tall 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
2	CO1		H			
	CO2		M			
	CO3		H			
	CO4		H			
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Total No. of Periods: 45

Text book:

1. Taranth B.S., Structural Analysis and Design of Tall Buildings, McGraw Hill, 1998.

References:

1. 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.
2. Wolfgang Schueller, High Rise Buildings Structures, John Wiley and Sons, 1977.
3. Bryan Stafford Smith, Alexcoull, Tall Buildings Structures, Analysis and Design, John Wiley and Sons, Inc., 2005.
4. T. Y. Lin, Stores, Burry, Structural Concepts and systems for Architects and Engineers, John Wiley, 1988.
5. Lynn Beedle, Advance m Tall Buildings, CBS Publishers and Distributors, Delhi 1986.

MST058		INDUSTRIAL STRUCTURES			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Design of steel structures						
		Course Designed by :Department of civil						
OBJECTIVES To understand the concepts of planning and functional requirements, roofs for industrial buildings in various structures and foundation designs.								
COURSE OUTCOMES (COs)								
CO1		To learn about special features and design aspects for the construction of environmental engineering structures.						
CO2		To know about analysis and design of water tanks.						
CO3		To understand the design of special purpose structures.						
CO4		To know about the diagnosing the cause and damage of structural and non						
CO5		To design the pre-stressed concrete pipes.						
Mapping of Course Outcomes with 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	M					
	CO2	H	M	L				
	CO3	H	M		L			
	CO4	H	M					
	CO5	H	M			L		

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

UNIT-I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines from Factories Act.

UNIT-II INDUSTRIAL BUILDINGS 10

Roofs for Industrial Buildings - Steel and RC. Folded Plates and Shell Roofs - Gantry Girders - Design of Corbels and Nibs.

UNIT-III POWER PLANT STRUCTURES 10

Bunkers and Silos, Chimneys and Cooling Towers. High Pressure boilers and piping design - Nuclear containment structures.

UNIT-IV POWER TRANSMISSION STRUCTURES 8

Cables – Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers.

UNIT-V MACHINE FOUNDATIONS 8

Planning and Design of Machine Foundations

Total No. of Periods: 45

References:

1. Procs. Of Advanced course on Industrial Structures, Structural Engineering Research Centre, 1982.
2. P Srinivasulu and C. V. Vaidyanathan. Handbook of Machine Foundations, Tata McGraw Hill 1976.
3. S.N. Manohar, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985.
4. AR. Santhakumar and S. S. Murthy, Transmission Line Structures, Tata McGraw Hill. 1992.

MST060	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: repair and rehabilitation of structures				
	Course Designed by :Department of civil				
OBJECTIVES To study the damages, repair and rehabilitation of structures..					

COURSE OUTCOMES (COs)						
CO1	To learn about general consideration in quality assurance, structural appraisal etc					
CO2	To know about techniques for repair in building cracks					
CO3	To understand the reason for ineffective DPC and remedial treatments					
CO4	To know about types, causes for deterioration and preventive measures					
CO5	To learn the concepts of strengthening of existing 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
2	CO1	H	M		L	
	CO2	M	M	L		
	CO3	M	M		L	L
	CO4	M	M			
	CO5	M	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PPS)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION

9

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.

UNIT II BUILDING CRACKS

9

Causes – diagnosis – remedial measures – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Techniques for repair – Epoxy injection.

UNIT III MOISTURE PENETRATION

9

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay – Chemical coatings – Flexible and rigid coatings.

UNIT IV DISTRESSES AND REMEDIES

9

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements. Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against

corrosion – Design and fabrication errors – Distress during erection. Masonry Structures: Discoloration and weakening of stones – Biotical treatments – Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures.

UNIT V STRENGTHENING OF EXISTING STRUCTURES 9

General principle – relieving loads – Strengthening super structures – plating – Conversion to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening the substructures – under pinning – Increasing the load capacity of footing – Design for rehabilitation.

Total No. of Periods: 45

References:

1. Allen R.T and Edwards S.C, “Repair of Concrete Structures”, Blakie and Sons, UK, 1987
2. Dayaratnam.P and Rao.R, “Maintenance and Durability of Concrete Structures”, University Press, India, 1997.
3. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical, UK, 1991.
4. Dodge Woodson.R, “Concrete Structures – protection, repair and rehabilitation”, Elsevier Butterworth – Heinmann, UK, 2009.
5. Peter H.Emmons, “Concrete Repair and Maintenance Illustrated”, Galgotia Publications Pvt. Ltd., 2001.
6. Raikar, R.N., “Learning from failures - Deficiencies in Design, Construction and Service” – Rand D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

MST061		OFFSHORE STRUCTURES			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Design of Bridges						
		Course Designed by :Department of civil						
OBJECTIVES To study the optimization methodologies applied to structural engineering								
COURSE OUTCOMES (COs)								
CO1		To know the basic concept in wave theories						
CO2		To study the forces of off shores structures						
CO3		To learn the foundation concept						
CO4		To analyze the modeling of structures						
CO5		To design the off shore 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		
2	CO1	H	M					
	CO2	H	H	M				

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

UNIT-I WAVE THEORIES 8

Wave generation process, small and finite amplitude wave theories.

UNIT-II FORCES OF OFFSHORE STRUCTURES 8

Wind forces, wave forces on vertical, inclined cylinders, structures-current forces and use of Morison equation.

UNIT-III OFFSHORE SOIL AND STRUCTURE MODELING 9

Different types of offshore structures, foundation modeling, and structural modeling.

UNIT-IV ANALYSIS OF OFFSHORE STRUCTURES 10

Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT-V DESIGN OF OFFSHORE COMPONENTS 10

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

Total No. of Periods: 45

References:

1. Chakrabarti,S.K. “Hydrodynamics of Offshore Structures”, Computational Mechanics Publications, 1987.
2. Thomas H.Dawson, “Offshore Structural Engineering”, Prentice Hall IncEnglewood Cliffs, N.J. 1983.
3. API. “Recommended Practice for Planning Designing and Constructing Fixed Offshore Platforms”. American Institute Publication, RP2A Dalls.Tex.
4. Wiegel, R.L. Oceanographical Engineering, Prentice Hall Inc., Englewood Cliffs.N.J.1964.
5. Brebia. C.A Walker, S. Dynamic Analysis of Offshore Structures. Vol.1, Krieger Publishing Company, Malabar, Florida, 1991.
6. Reddy.D.V and Arockiaswamy.M , Offshore Structures, Vol.1., Krieger Publishing Company Malabar, Florida, 1991.

MST062		OPTIMIZATION IN STRUCTURAL DESIGN		L	T	P	C
		Total Contact Hours: 45		3	0	0	3
		Prerequisite: Design of structural steel					
		Course Designed by :Department of civil					
OBJECTIVES To study the optimization methodologies applied to structural engineering							
COURSE OUTCOMES (COs)							
CO1		To know the basic concept in optimization of structures					
CO2		To analyze programming methods for optimal design of structures					
CO3		To study the plastic design of structures					
CO4		To learn the optimization methods					
CO5		To understand the optimization by structural theorems					
Mapping of Course Outcomes with 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			
	CO2	H	M				
	CO3	H		M			
	CO4	H			L		
	CO5	H				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
				√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

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 Search 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.

Total No. of Periods: 45**Reference:**

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.

MST063		PREFABRICATED STRUCTURE		L	T	P	C
		Total Contact Hours: 45		3	0	0	3
		Prerequisite: Concrete structures					
		Course Designed by :Department of civil					
OBJECTIVES To study the optimization methodologies applied to structural engineering							
COURSE OUTCOMES (COs)							
CO1		To know the general principles in prefabricated structures					
CO2		To analyze the design of slabs and framed structures					
CO3		To study the design of floors, stairs and roofs					
CO4		To learn the design of walls					
CO5		To analyze the design of industrial building					
Mapping of Course Outcomes with 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	M	M				
	CO2	H	M	L			
	CO3	H	M		L		
	CO4	H	M		L	L	
	CO5	H	M				

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

UNIT I INTRODUCTION 9

General Civil Engineering requirements, specific requirement for planning and layout of Prefabricates plant. IS code specifications.

DESIGN PRINCIPLES

Modular Co-ordination, standardization, Disuniting of Prefabricates, Production, transportation, erection, stages of loading and codal provisions, safety factors, material properties. Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II REINFORCED CONCRETE 6

Prefabricated Structures – Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs. Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells, Crane-gantry systems.

UNIT III FLOORS, STAIRS AND ROOFS 9

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements. Description of joints, their behaviour and reinforcement requirements. Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term load, ultimate strength calculations in shear and flexure.

UNIT IV WALLS 9

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, Vertical loads. Eccentricity and stability of wall panels, Design Curves, types of wall joint, their behaviour and design. Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT V DESIGN OF INDUSTRIAL BUILDINGS 12

Components of single-storey industrial sheds with crane gantry systems. Design of R.C. Roof Trusses, Roof Panels, Design of R.C. Crane-gantry girders, corbels and columns, wind bracing design.

DESIGN OF SHELL ROOFS FOR INDUSTRIAL SHEDS

Cylindrical, Folded plate and hyper-prefabricated shells. Erection and joining, joint design hand book based design

Total No. of Periods: 45

References:

1. B.Lewicki, Building with Large Prefabricates, Elsevier Publishing company, Amsterdam/London/New York, 1966.
2. Koncz T., Manual of Precast Concrete Construction, Vol. I,II and III, Bauverlag, GMBH, 1971.
3. Structural Design Manual, Precast Concrete Connection details, Society for the Studies in the use of Precast Concrete, Netherland BetorVerlag, 1978.

MST064		PRESTRESSED CONCRETE			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Reinforced Concrete Structures						
		Course Designed by :Department of civil						
OBJECTIVES Principle of pre - stressing, Analysis and design of pre - stressed concrete structures.								
COURSE OUTCOMES (COs)								
CO1		To know the principle of pre - stressing						
CO2		To analyze the design of end block and circular pre - stressing						
CO3		To know the design of compression members						
CO4		To learn the design of composite beams and application						
CO5		To understand the concept of pre - stressing in continuous beams						
Mapping of Course Outcomes with 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	M					
	CO2	H	M	M	M			
	CO3	H	M					
	CO4	H	M		M	L		
	CO5	H	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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.

Total No. of Periods: 45

Text books:

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.

References:

1. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons, Inc.1960.
2. Leonhardt. F., Prestressed Concrete, Design and Construction, Wilhelm Ernst and Shon, Berlin, 1964.
3. Freyssiner, Prestressed Concrete.
4. Military Engineers Hand Book.
5. Evans, R.H and Bennett, E.W. Prestressed Concrete, Champman and Hall, London, 1958.

MST065	STABILITY OF STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Theory of elasticity and plasticity				
	Course Designed by :Department of civil				
OBJECTIVES To study the concept of buckling and analysis of structural elements.					
COURSE OUTCOMES (COs)					

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.

Total No. of Periods: 45**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.

MST066		THEORY OF PLATES				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Design Of RC Framed Structures							
		Course Designed by :Department of civil							
OBJECTIVES To study the behavior and analysis of thin plates, anisotropic and thick plates									
COURSE OUTCOMES (COs)									
CO1		To study about the thin plates with differential equations							
CO2		To analyze the rectangular plates by navies and levy’s method							
CO3		To know the Symmetrical bending of circular plates							
CO4		To learn the finite elements methods							
CO5		To know the about orthotropic plates							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	M						
	CO2	H	M						
	CO3	H			L	L			
	CO4	H	M	M					
	CO5	H							

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

UNIT I THIN PLATES 10

Thin Plates with small deflection, Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT II ANALYSIS METHODS 10

Rectangular plates. Simply supported rectangular plates, Navier's solution and Levy's method, Rectangular plates with various edge conditions.

UNIT III CIRCULAR PLATES 10

Symmetrical bending of circular plates, plates on elastic foundation.

UNIT IV SPECIAL AND APPROXIMATE METHOD 8

Energy methods, Finite difference and Finite elements methods.

UNIT V ANISOTROPIC PLATES AND THICK PLATES 7

Orthotropic plates and grids, moderately thick plates.

Total No. of Periods: 45

References:

1. Szilard. R., Theory of analysis of Plates, Prentice Hall Inc.
2. Timoshenko, S. and Krieger S.W. Theory of Plates and Shells McGraw Hill Book Company, New York 1990.

MST067	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Coastal Engineering				
	Course Designed by :Department of civil				
OBJECTIVES To study the concept of wind and cyclone effects for the analysis and design of structures					
COURSE OUTCOMES (COs)					
CO1	To know the basic concept in spectral studies				

CO2		To have knowledge about wind tunnels				
CO3		To study about the effect of wind on structures				
CO4		To understand the design method				
CO5		To know the cyclone effect on 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
2	CO1	H		L		
	CO2	M	M			
	CO3	M	M			
	CO4	M		M	L	
	CO5	M				L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION 10

Introduction Spectral studies, Gust factor, Wind velocity, Method of measurement, Variation of speed with height, shape factor, aspect ratio: drag effects.

UNIT II WIND TUNNEL STUDIES 5

Wind Tunnel Studies, Types of tunnels, modeling requirement. Interpretation of Results, Aero-Elastic Model.

UNIT III EFFECT OF WIND ON STRUCTURES 12

Wind on structures, Rigidity structures, Flexible structures, Static and dynamic effects. Tall buildings, chimneys.

UNIT IV DESIGN OF SPECIAL STRUCTURES 12

Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters.

UNIT V CYCLONE EFFECTS 6

Cyclone effect on Structures, cladding design, window glass design.

Total No. of Periods: 45

Text books:

1. Cook,N.J. The Designer's Guide to Wind Loading of Building Structures, Butter-worths, 1989.
2. Kolousek. Et at., Wind Effect on Civil Engineering Structures, Elsevier Publications , 1984.

Reference:

1. Peter Sachs, Wind Forces in Engineering , Pergamon Press ,New York, 1972.
2. Lawson T.V., Wind Effects on Building Vol. I and II, Applied Science Publishers, London, 1980.

MST068		DESIGN OF SHELL AND SPATIAL STRUCTURES			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Industrial structures						
		Course Designed by :Department of civil						
OBJECTIVES Study the behavior and design of shells, folded plates, space frames and application of FORMIAN software								
COURSE OUTCOMES (COs)								
CO1		To understand the types of shells						
CO2		To have knowledge about structural behavior of shells						
CO3		To study about the general principles						
CO4		To understand the design of space frames						
CO5		To know the optimization of structures						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H						
	CO2	H	M	H				
	CO3	H						
	CO4	H			L	L		
	CO5	H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				

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

UNIT I INTRODUCTION OF SHELLS 10

Classification of Shells, types of Shells, Structural action, membrane theory, Shells of revolution and Shells of translation, examples, limitations of membrane theory.

UNIT II FOLDED PLATES - ANALYSIS & DESIGN 10

Folded plate Structures, Structural behaviour, types, design by ACI- ASCE Task Committee method.

UNIT III SPACE FRAMES 5

Space frames- Configuration- types of nodes- general principles of design Philosophy- Behaviour.

UNIT IV ANALYSIS & DESIGN OF SPACE FRAMES 10

Analysis of Space frames- Formex Algebra, FOR MAIN – detailed design of space frames.

UNIT V OPTIMIZATION 10

Optimization by Structural theorems- Maxwell, Mirchell and Heyman's Theorems for trusses and frames, fully Stressed design with deflection constraints, genetic Algorithm.

Total No. of Periods: 45

References:

1. Wilhelm Flugge, stresses in shells, Springer- Verlag
2. Timoshenko, S. Theory of Plates and Shells, McGraw Hill, 1990
3. Ramasamy, G.S., Design and Construction of Concrete Shells Roofs, CBS publishers, 1986.
4. Principles of Space Structures by Dr. N. Subramanian- 1999, Wheeler Publishing Co.
5. Proceedings of International Conference of Space Structures, AnnaUniversity, November 1997.
6. Uri krish, Optimum Structural Design, McGraw Hill Book Co. 1981.

MST069	DISASTER RESISTANT STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Repair and Rehabilitation of structures				
	Course Designed by :Department of civil				
OBJECTIVES To know the various types of disasters caused by the natural and disaster prone areas in India					
COURSE OUTCOMES (COs)					
CO1	To understand the behavior concept of structures				
CO2	To have knowledge about response of the structure for various disasters				
CO3	To understand detailing of structures				
CO4	To know about various modern materials				
CO5	To have idea about assessment of structures				

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	M				
	CO2				L	
	CO3	H				
	CO4		H			L
	CO5	M		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 construction 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.

Total No. of Periods: 45

Text books:

1. V. Moshirin 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.

References:

1. Proceedings IABSE 14th Congress “Civilisation through Civil Engineering”- New Delhi, May 1992.
2. Raiker R.N. Learning from failures Deficiencies in Design, Construction and Service R&D Centre (SDCPL) Raiker Bhavan, Bombay 1987.

LIST OF OPEN ELECTIVE (OE)

MST070		RESEARCH METHODOLOGY			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Professional Courses						
		Course Designed by :Department of civil						
OBJECTIVES To know the various types of Formulation of Research Task, modeling and simulation, analysis of reports and report writing.								
COURSE OUTCOMES (COs)								
CO1		To understand the basic concept of Formulation of Research Task.						
CO2		To have knowledge about mathematical modeling and simulation						
CO3		To understand experimental modeling.						
CO4		To know about of analysis of report.						
CO5		To know about of concept of report writing.						
Mapping of Course Outcomes with 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	M	M					
	CO2	H	M		L			
	CO3	H	M					
	CO4	M	M		L	L		
	CO5	M	M	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I RESEARCH CONCEPTS**9**

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT-II MATHEMATICAL MODELING AND SIMULATION 9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT-III EXPERIMENTAL MODELING 9

Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT-IV ANALYSIS OF RESULTS 9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT-V REPORT WRITING 9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

Total No. of Periods: 45

TEXT BOOKS

1. Willktsion K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, „Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, „Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

MST057	ENVIRONMENTAL ENGINEERING STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Environmental Science				
	Course Designed by :Department of civil				

OBJECTIVES To understand the concepts of water tank designs, purpose of special structures and diagnosing the cause and damage.						
COURSE OUTCOMES (COs)						
CO1	To learn about special features and design aspects for the construction of environmental engineering structures.					
CO2	To know about analysis and design of water tanks.					
CO3	To understand the design of special purpose structures.					
CO4	To know about the diagnosing the cause and damage of structural and non-structural cracks					
CO5	To design the pre-stressed concrete pipes.					
Mapping of Course Outcomes with 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				
	CO2	H	M	M	L	
	CO3	H				L
	CO4	H				
	CO5	H	M			L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

4

IS codes for design of water retaining structures. Special features and design aspects for the construction of environmental engineering structures.

UNIT II ANALYSIS AND DESIGN OF WATER TANKS

12

Design of concrete roofing system a) Cylindrical domes b) Conical domes design of folded plates for roofing with concrete. (V Type only)

UNIT III DESIGN OF SPECIAL PURPOSE STRUCTURES

12

Underground reservoirs and swimming pools, Structural design including foundation of water retaining structures such as settling tanks, clari-floculators, aeration tanks etc., -effect of earth pressure and uplift considerations – selection of materials of construction.

UNIT IV REPAIR AND REHABILITATION OF STRUCTURES

12

Diagnosing the cause and damage, identification of different types of structural and non-structural cracks - repair and rehabilitation methods for Masonry, Concrete and steel Structures.

UNIT V DESIGN OF PIPES

5

Structural design of reinforced cement concrete, pr-stressed concrete pipes.

Total No. of Periods: 45

Text book:

1. Reinforced Concrete by P. Dayaratnam
2. Prestressed Concrete by Krishna Raju. Tata McGraw Hill Publishing Co.2nd Edition 1988.
3. Reinforced Concrete by N.C. Sinha & S.K. Roy – S. Chand and Co. 1985.

References:

1. Hulse R., and Mosley. W.H., Reinforced concrete Design by Computer, Macmillan Education Ltd., 1986
2. Ramaswamy, G.S., Design and Construction of Concrete shell roofs, CBS Publishers, India 1986.
3. Greem, J.K. and Perkins, P.H. Concrete liquid retaining structures. Applied Scienmce Publishers, 1981.

MST070	RESEARCH METHODOLOGY					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Professional Courses								
	Course Designed by : Department of Civil Engineering								
OBJECTIVES									
- To Get adequate knowledge about research concepts - To describe mathematical modeling and simulation - To understand experimental modeling - To get knowledge about the interpretation of result									
COURSE OUTCOMES (COs)									
CO1		To describe research concepts.							
CO2		To Get adequate knowledge about mathematical modeling							
CO3		To describe experimental modeling							
CO4		To understand analysis of results							
CO5		To know about report writing							
Mapping of Course Outcomes with 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	M	L	M	M			
	CO2	H	M	L	M	M			
	CO3	H	M		M	M			
	CO4	H	M	L	M	M			
	CO5	H	M		M	M			

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

I. RESEARCH CONCEPTS

9

II. Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

II MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

III EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

IV ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

V REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.

2. Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CURRICULU AND SYLLABUS (R20150)
CHOICE BASED CREDIT SYSTEM

M.TECH – ENVIRONMENTAL ENGINEERING
(FULL TIME)
I – IV SEMESTERS

SEMESTER – I							
S.No	Category	Code	Subject Name	L	T	P	C
1	PM	MMA108	Statistics for Environmental Engineers	4	0	0	4
2	PC	MER101	Environmental Chemistry	3	0	0	3
3	PC	MER102	Environmental Microbiology	3	0	0	3
4	PC	MER103	Air Pollution and Control	3	0	0	3
5	PC	MER104	Water and Sewage Conveyance	3	0	0	3
6	PC	MER1L1	Environmental Engineering Lab	0	0	4	2
			Total	16	0	4	18

SEMESTER – II

S.No	Category	Code	Subject Name	L	T	P	C
1	PC	MER201	Solid and Hazardous Waste Management	3	0	0	3
2	PC	MER202	Physical and Chemical Treatment of Water and Wastewater	3	1	0	4
3	PC	MER203	Biological Treatment of Wastewater	3	0	0	3
5	PC	MER204	Industrial Wastewater Management	3	0	0	3
6	PE	MER2E1	Professional Elective – I	3	0	0	3
7	PE	MER2E2	Professional Elective – II	3	0	0	3
8	PE	MER2E3	Professional Elective – III	3	0	0	3
			Total	21	1	0	22

SEMESTER – III

S.No	Category	Code	Subject Name	L	T	P	C
1	PE	MER3E1	Professional Elective – IV	3	0	0	3
2	PE	MER3E2	Professional Elective – V	3	0	0	3
3	OE	MER3E3	Open Elective	3	0	0	3
4	PR	MER3P1	Project Work (Phase – I)	0	0	12	6
			Total	9	0	12	15

SEMESTER – IV

S.No	Category	Code	Subject Name	L	T	P	C
1	PR	MER4P1	Project Work (Phase – II)	0	0	24	12
			Total	0	0	24	12

Total Credits for the Programme – 67

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE (PE I)

S.No.	Code	Subject Name	L	T	P	C
1	MER051	Environmental Quality Modeling	3	0	0	3
2	MER052	Instrumental Monitoring of Environment	3	0	0	3
3	MER067	Advanced Oxidation Process	3	0	0	3

PROFESSIONAL ELECTIVE (PE II)

S.No.	Code	Subject Name	L	T	P	C
4	MER055	Ground Water Contamination and Transport Modelling	3	0	0	3
5	MER058	Indoor Air Quality	3	0	0	3
6	MER065	Environmental Impact Assessment	3	0	0	3

PROFESSIONAL ELECTIVE (PE III)

S.No.	Code	Subject Name	L	T	P	C

7	MER054	Ecological Engineering	3	0	0	3
8	MER056	Environmental Bio Technology	3	0	0	3
9	MER057	Membrane Separation for Water and Wastewater Treatment	3	0	0	3

PROFESSIONAL ELECTIVE (PE IV)

S.No.	Code	Subject Name	L	T	P	C
10	MER060	Environmental Policies and Legislation	3	0	0	3
11	MER064	Unit Operations and Unit Processes in Environmental Technology	3	0	0	3
12	MER059	Landfill Engineering and Remediation Technology	3	0	0	3

PROFESSIONAL ELECTIVE (PE V)

S.No.	Code	Subject Name	L	T	P	C
13	MER063	Marine Pollution Monitoring	3	0	0	3
14	MER053	Remote Sensing and GIS for Environmental Applications	3	0	0	3
15	MER062	Mass Transfer In Air – Water Soil Interaction	3	0	0	3

LIST OF OPEN ELECTIVES

S.No.	Code	Subject Name	L	T	P	C
16	MER061	Environmental Engineering Structures	3	0	0	3
17	MER066	Environment, Health and Safety in Industries	3	0	0	3
18	MER068	Research Methodology	3	0	0	3

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)	4	-	-	-	4	5.97
2	Professional Core (PC)	14	13	-	-	27	40.29
3	Professional Electives (PE)	-	9	6	-	15	22.38
5	Open Electives (OE)	-	-	3	-	3	4.47
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	6	12	18	26.86
	Total Credits	18	22	15	12	67	100
	Total Contact Hours	20	22	21	24	87 HRS	

SYLLABUS

MMA108	STATISTICS FOR ENVIRONMENTAL ENGINEERS				L	T	P	C
	Total Contact Hours:45				4	0	0	4
	Prerequisite: Numerical Methods							
	Course Designed by :Department of Civil							
OBJECTIVES To Train the students in the analysis of Environmental data using Statistical tools								
COURSE OUTCOMES (COs)								
CO1	To make them understand the measures of Central tendency and Dispersion for grouped ungrouped Data.							
CO2	To know the basics of estimation theory and Curve fitting by Principles of least squares and Regression lines.							
CO3	To understand about Sampling distributions							
CO4	To improve the knowledge on Design of Experiments and Analysis of variance							
CO5	To know about the Statistical Policy Control and Statistical quality control							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	PO1	PO2	PO3	PO4	PO5		
2	CO1	H		M	L			
	CO2	M		H		L		
	CO3	L	M			H		
	CO4	H		M	L			
	CO5	L		M		H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√						

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

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.Montgomery, D.C and Runger .G.C.,” Applied Statistics and probability for Engineers”, Wiley Student Edition.2007.
- 2.Walpole,R.E.Myers, R.H,Mters,S.L.andye.K.”Probability and statistics forengineers and scientists “ Pearson education, Asia ,8th edition,2007.
- 3.Mann.P.S.”Introductory Statistics” John wiley and sons, Inc 5th edition,2004.

4.Johnson.R.A.andgupta,C.B.” Miller and Freund’s Probability and statistics for Engineers ,”
Pearson education,Asia,7th edition,2007.

MER101	ENVIRONMENTAL CHEMISTRY				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:Environmental studies							
	Course Designed by : Department of Civil Engineering							
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)								
CO1	To make them understand the fundamentals of chemistry, mainly green Chemistry and chromatographic principles							
CO2	To know the basics of degradation principles, mainly degradation of pesticides, food stuffs etc.							
CO3	To understand about the basics of aquatic chemistry and redox reactions							
CO4	To improve the knowledge on the fundamentals of atmospheric Chemistry and various regions of atmosphere							
CO5	To know about the soil Chemistry,salt and ion exchange theory							
Mapping of Course Outcomes with 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	L	M		H			
	CO2	L			M	H		
	CO3		H	L	M			
	CO4		H	L	M			
	CO5	M	H		M			

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

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 DEGRADATION

9

Transport and Transformation Of Chemicals – DO, BOD And COD – Photo Catalysis – Degradation of Food Stuffs, Detergents, Pesticides And Hydrocarbons.

UNIT-III AQUATIC CHEMISTRY

9

Metals, Complex Formation, Oxidation And Reduction And Sorption – Eh – PH Diagrams- Chemical Speciation – QSAR – Risk Evaluation Of Chemicals.

UNIT-IV ATMOSPHERIC 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

Total Periods : 45

REFERENCES:

- 1.C.N. Sawyer, P.L. MacCarty and G.F. Parkin , Chemistry for Enviromental Engineering and Science , Tata McGraw – Hill, fifth edition, New Delhi, 2003.
- 2.G.W. Vanloon and S.J. Duffy “Environmental Chemistry - a global perspective oxford university press, New York ,2000.
- 3.D.W. Connell, Basic concepts of Environmental Chemistry , Lewis publishers, New York, 1997.
- 4.Colin Baird ,“Environmental Chemistry” , Freeman and Company, New York, 1997.
5. S.E. Manathan, Environmental Chemistry , Sixth Edition, Lewis Publishers, New York, 1994.

MER 102	ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering-I,II				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					
To educate the students in microbiology and its applications in environmental engineering, and train them in experiments related to microbiological examination of water.					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of classification of micro organisms,its culturing modes.				
CO2	To know the basics of microbiology of environment and the distribution of microorganisms on land,air,water.				
CO3	To understand about the metabolism of micro organisms and various modes of respiration.				

	in detail					
CO4	To improve the knowledge on the Biodegradation of toxic pollutants and its mechanism					
CO5	To know about the basics of the branch of toxicology and the term ecotoxicology					
Mapping of Course Outcomes with 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	L	H		M	
	CO2		H	L		M
	CO3	M		H		L
	CO4	H		L		M
	CO5		M	L		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.Montgomery, D.C and Runger .G.C.,” Applied Statistics and probability for Engineers”, Wiley Student Edition.2007.
- 2.Walpole,R.E.Myers, R.H,Mters,S.L.andye.K.”Probability and statistics forengineers and scientists “ Pearson education, Asia ,8th edition,2007.
- 3.Mann.P.S.”Introductory Statistics” John wiley and sons, Inc 5th edition,2004.
- 4.Johnson.R.A.andgupta,C.B.” Miller and Freund’s Probability and statistics for Engineers ,” Pearson education,Asia,7th edition,2007.

MER103	AIR POLLUTION AND CONTROL	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental studies				

		Course Designed by : Department of Civil Engineering				
OBJECTIVES To educate the students on various methods of control of particulate and gaseous air pollutants						
COURSE OUTCOMES (COs)						
CO1	To make them understand the fundamentals of air quality management classification of micro organisms,its culturing modes.					
CO2	To understand about the methods of particulate control like gravitational and centrifugal filters					
CO3	To understand in detail about the phenomenon of adsorption and absorption thus explaining more on control of gaseous air contaminants.					
CO4	To improve the knowledge on the emerging trends of air pollution control and discuss in detail about automobile air pollution					
CO5	To know about the basics of the standards of noise pollution and methods to prevent air pollution					
Mapping of Course Outcomes with 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	L	H		M	
	CO2	H		M		L
	CO3	H		L	M	
	CO4	L			H	M
	CO5	H		L	M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Total Periods : 45

REFERENCES:

- 1.LawrenceK.Wang, Norman C Perelra, Yung- Tse Hung, “Air Pollution Control Engineering”, Tokyo, 2004.
- 2.Noel de Nevers, Air Pollution Control Engg.,McGraw-Hill, New York, 1995.
- 3.David H.F Liu, BelaG.Liptak “Air Pollution”, Lewis Publishers, 2000.

MER104	WATER AND SEWAGE CONVEYANCE	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Environmental Engineering-I,II				
	Course Designed by : : Department of Civil Engineering				
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					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of hydraulic engineering and the various fluid flow phenomenon				
CO2	To understand about the methods of water transmission and distribution and the economics related to water transmission				
CO3	To understand in detail about the waste water collection and conveyance and also the maintenance of sewers and design of sewer outfalls				
CO4	To improve the knowledge on the planning and estimation of storm water flow				

CO5	To know about the basics of the Case Studies and Computer applications for water transmission					
Mapping of Course Outcomes with 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	M			L
	CO2		M	L		H
	CO3		M	L		H
	CO4		M	L		H
	CO5	L			H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Total Periods : 45

REFERENCES:

- 1.G.S.Bajwa, Practical Handbook on Public Health Engineering, Deep Publishers, Shimla, 2003.
- 2.“Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, Gol, New Delhi, 1999.
- 3.“Manual on sewerage and Sewage Treatment’, CPHEEO, Ministry of Urban Development, Gol, New Delhi, 1993.
- 4.B.A. Hauser, Practical Hydraulics Handbook, Lewis Publishers, New York, 1991.

MER1L1	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
	Total Contact Hours:45	0	0	4	2
	Prerequisite: Environmental Engineering-I				
	Course Designed by : : Department of Civil Engineering				
OBJECTIVESTo conduct laboratory studies on water and wastewater treatment units					
COURSE OUTCOMES (COs)					

CO1	To know about about the basic water sample analysis techniques used in water as well as waste water testing.					
CO2	To know the principle of Air quality analysis to analyse major components of air like SO ₂ ,NO ₃ etc					
CO3	Having a deep knowledge about soil analysis techniques					
CO4	With a true wisdom about serial dilution techniques and methods to prepare pure culture					
CO5	Having a sound knowledge in the bacteriological analysis of waste water.					
Mapping of Course Outcomes with 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			L	M	H
	CO2		M	L		H
	CO3		H		M	L
	CO4		M	L	H	
	CO5		L		H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Environmental Chemistry Laboratory

1. Physical and Chemical Analysis of Water

12

Ph, Conductivity, Turbidity, Solids, Chlorides, Sulphates, Alkalinity, Fluorides, Nitrate and heavy metals.

2. Physical and Chemical Analysis of Wastewater

8

Phosphate, COD, BOD, Organic and ammonical nitrogen, Oil & grease.

3. Air Quality Analysis **6**
SPM, SO₂, CO, NO_x

4. Soil Analysis **4**
pH, Conductivity, Cation exchange capacity, Sodium Absorption ratio

30

Environmental Microbiology Laboratory

1. Preparation of media, serial dilution and plating, Growth curve	6
2. Sampling of Microorganisms from air, water and soil, staining-simple and gram staining.	6
3. Effect of pH, temperatures and nutrients on growth of bacteria	2
4. Bacteriological analysis of water – Coli forms and streptococcus fecalis by MPN and membrane filter techniques	10
5. Study of aquatic organisms – Algae, Protozoa and fungi	6

30

MER201	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Environmental Health Engineering				
	Course Designed by : Department of Civil Engineering				
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)					
CO1	To make them understand the fundamentals of solid and hazardous wastes and also the types, need and sources of solid and hazardous wastes.				
CO2	To understand about the methods of waste characterisation and source reduction and to study the various methods of generation of wastes.				
CO3	To understand in detail about the storage, collection and transport of wastes.				

	and also to study about the methods used for handling and segregation of wastes.					
CO4	To improve the knowledge on the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes					
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.					
Mapping of Course Outcomes with 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		M	L
	CO2		M		L	H
	CO3		H		L	M
	CO4		M		L	H
	CO5		L		M	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION

9

Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management- Elements of integrated waste management and roles of stakeholders- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, plastics and fly ash, financing waste management.

UNIT-II WASTE 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.

Total Periods : 45

REFERENCES:

- 1.George Tchobanoglous, Hilary Theisen and Samuel A, Vigil “Integrated Solid Waste Management, McGraw- Hill International edition, New York, 1993.
- 2.CPHEEO “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.

3.Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, McGraw- Hill International edition, New york, 2001.

4.Vesilind P.A., Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.

MER202	PHYSICAL AND CHEMICAL TREATMENT OF WATER AND WASTEWATER				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Unit Operations and Unit Processes in Environmental Technology							
	Course Designed by : Department of Civil Engineering							
OBJECTIVES								
To educate the student on the working principles and design of various physical and chemical treatment systems for water and wastewater.								
COURSE OUTCOMES (COs)								
CO1	To make them understand the fundamentals of waste water treatment .To learn about the various Pollutants in water and waste water and also to study about their characteristics							
CO2	To understand about the methods of waste characterization , source reduction and to study the various methods of generation of wastes.							
CO3	To understand in detail about the various principles of chemical treatment which include precipitation coagulation etc.							
CO4	To improve the knowledge on the Selection of unit operation and processes and to study the design oriented aspects of sand filters and other treatment processes.							
CO5	To know about the basics of the design of industrial waste water treatment and reclamation 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		
2	CO1		H		L	M		
	CO2	H	M			L		
	CO3	H	M			L		
	CO4	H	M			L		

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

UNIT-I INTRODUCTION

9

Pollutant in water and wastewater – characteristics, standards for performance – significant and need for physic – chemical treatment.

UNIT-II PHYSICAL TREATMENT PRINCIPLES

9

Principles of screening – mixing, equalizations –sedimentation – filtration –modeling – backwashing –evaporation-incineration- gas transfer-mass transfer coefficients. Adsorption-isotherms-principles, equilibrates and kinetics, reactors, regeneration, membrane separation, reverse osmosis, nano filtration ultra filtration and hyper filtration – electro dialysis, distillation – stripping and crystallization-recent advances.

UNIT-III CHEMICAL TREATMENT PRINCIPLES

9

Principles of chemical treatment – coagulation flocculation – precipitation –floatation, solidification and stabilization- disinfection .ion exchange, electrolytic methods -Solvent extraction –advanced oxidation / reduction –recent advances.

UNIT-IV DESIGN OF CONVENTIONAL TREATMENT PLANTS

9

Selection of unit operation and processes – design of conventional water treatment plant units – aerators –chemical feeding –flocculation –clarifier – filters –rapid sand filter, slow sand filter, pressure filter-chlorinators. Displacement and gaseous type.layouts- flowcharts –hydraulic

profile –O & M aspects- case studies , residue management – up gradation of existing plants – recent advances.

UNIT-V DESIGN OF INDUSTRIAL WATER TREATMENT AND RECLAMATION 9

Selection of process –design of softeners – demineralisers –wastewater reclamation – reverse osmosis plants –residue management – O & M aspects –recent advances –case studies.

Total Periods : 45

REFERENCES:

- 1.Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse Tata McGraw-Hill, New Delhi, 2003.
- 2.Manual on water supply and Treatment CPHEEO, Ministry of Urban Development ,GOI, New Delhi,1999.
- 3.Lee ,CC and Shun dar Lin , Handbook of Environmental Engineering Calculations , McGraw-hill,Newyork , 1999.
- 4.Qasim,S.R motely, E.N., Zhu, G. water works Engineering – planning ,design and operation,PrenticeHall,New Delhi, 2002.
- 5.Casey, T.J.Unit treatment processes in water and wastewater Engineering, John Wiley and Sons, London1993.

MER203	BIOLOGICAL TREATMENT OF WASTEWATER	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering-II				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					
To educate the students on principles and design of various biological treatment units used for wastewater treatment.					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of biological treatment and its significance aerobic and anaerobic waste water treatment along with its kinetic studies.				
CO2	To understand about the methods of aerobic treatment of wastewater which includes				

	design of trickling filter, rotating biological contactor, activated slide process					
CO3	To understand in detail about the anaerobic treatment of wastewater which includes design of attached and suspended growth, along with UASB.					
CO4	To improve the knowledge on the sludge treatment and disposal and the recent advancements in this field.					
CO5	To know about the operations, maintenance, management and case studies related to biological treatment of waste water.					
Mapping of Course Outcomes with 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		M		H	L
	CO2	H			M	L
	CO3	H			M	L
	CO4	H			M	L
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

Design of 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 –flow charts, layouts hydraulic profile-recent advances.

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

Design of 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 AND CASE STUDIES 9

Operational problems-trouble shooting, planning, organizing and controlling of plants operations- capacity building, case studies on sewage treatment plants- sludge management facilities.

Total Periods : 45

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.

MER204	INDUSTRIAL WASTEWATER MANAGEMENT	L	T	P	C

		Total Contact Hours:45				3	0	0	3
		Prerequisite:Industrial Waste Treatment and Disposal							
		Course Designed by : Department of Civil Engineering							
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)									
CO1		To make them understand the fundamentals of uses of water by industry-sources and types of industrial wastewaters							
CO2		To understand about the methods of prevention vs. control of industrial pollution including the various benefits and barriers							
CO3		To understand in detail about the Industrial Wastewater Treatmentand all the processes in detail.							
CO4		To improve the knowledge on the emerging trends of wastewater reuse and residual management							
CO5		To know about the case studies which involves the various industrial manufacturing 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			
2	CO1			L	M	H			
	CO2		M	L		H			
	CO3		H		M	L			
	CO4		M	L	H				
	CO5		L		H	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						

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

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.

Total Periods : 45

REFERENCES:

- 1.Eckenfelder,W.W., “Industrial Water Pollution Control”, McGraw-Hill, 1999.
- 2.Arceivala, S.J., “Wastewater Treatment for Pollution Control”, Tata McGraw-Hill. 1998.
- 3.Frank Woodard Industrial Waste treatment Handbook,ButterworthHeinemann,New Delhi, 2001.
- 4.World Bank Group, “Pollution Prevention and Abatement Handbook-Towards Cleaner Production,World Bank and UNEP,Washington D.C.1998.
- 5.Paul L.Bishop “Pollution Prevention;- Fundamentals and practice”, McGraw-Hill International, 2000

MER051	ENVIRONMENTAL QUALITY MODELLING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES To educate the students on the basic principles,development and application of air and water quality models with computer applications.					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of mathematical Modeling and explain how modeling can be used as as a tool in assessing environmental quality				
CO2	To understand about the methods of application of these models in simulation, parameter estimation and experimental design.				
CO3	To understand in detail about the water quality modeling process ,dissolved oxygen models and models on Groundwater				
CO4	To improve the knowledge on the emerging trends of air pollution modeling and prediction,performance and its utilization				
CO5	To know about the various case studies on air quality modeling and water quality				

		modeling and other software package 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		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION

9

Basics of mathematical Modeling- Modeling as a tool.Procedures of model development.Importance of model building.Characteristics of deterministic models.Classical approach to constrained and unconstrained optimization. State of the art in environmental engineering systems models-climate and system modeling-Erosion and sediment transport.

UNIT-II COMPUTER BASED SOLUTIONS

9

Formulation of linear optimization models.Linear programming.Sensitivity testing and duality.Solution techniques and computer programming; Formulation of linear optimization models.Application of models-simulation, parameter estimation and experimental design.

UNIT-III WATER QUALITY MODELLING

9

Rivers and streams water quality modeling-river hydrology and flow-low flow analysis-dispersion and mixing-flow, depth; water quality modeling process-model sensitivity-assessing model performance; Models for dissolved oxygen, pathogens; Groundwater modeling.

UNIT-IV AIR QUALITY MODELLING

9

Air pollution modeling and prediction, modeling technique, modeling for non reactive pollutants, single source short term impact; multiple sources and area sources, model performance, accuracy and utilization.

UNIT-V CASE STUDIES

9

Software package applications: Air quality modeling and water quality modeling.

Total Periods : 45

REFERENCES:

1. John Wainwright and Mark Mulligan, Environmental Modelling Finding Simplicity in Complexity, John Wiley and sons Ltd, USA, 2004
2. Dynamic Modeling of Environmental Systems by Deaton and Wine brake, Wiley & Sons, 2002.
3. Steven C. Chapra, Surface water quality modeling, McGraw-Hill Inc., New York, 1997.
4. Boubel R.W., Fox, D.L., Turner D.B.& Stern, A C. "Fundamentals of Air Pollution, Academic Press, New York,1994.

MER052	INSTRUMENTAL MONITORING OF ENVIRONMENT	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering I,II				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					
To educate the students on the various instruments used for analysis of air water and soil.					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of various Instrumental methods in monitoring the environment.				

CO2	To understand about the various Spectroscopic Methods of determining the precision and accuracy of the instrument.					
CO3	To understand in detail about the Chromatographic methods of separation and the classification of these methods in detail.					
CO4	To improve the knowledge on the various Electro and Radio Analytical Methods of instrumentation					
CO5	To know about the various Continuous Monitoring Instruments such as NDIR analyzers					
Mapping of Course Outcomes with 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		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 NO_x, fluorescent analyzer for SO₂, auto analyzer for water quality using flow injection analysis, permeation devices.

Total Periods : 45

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.

MER053	REMOTE SENSING AND GIS FOR ENVIRONMENTAL APPLICATION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Remote Sensing and GIS				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES To educate the students on the principles and application of remote sensing and GIS in environmental engineering.					

COURSE OUTCOMES (COs)						
CO1	To make them understand the principles of Electro Magnetic Radiation and also the concepts of remote Sensing					
CO2	To understand about the Remote Sensing Platforms,various sensors used and also about the various Indian space programmed satellite data products.					
CO3	To understand in detail about the Data Processing and image processing techniques and softwares used in GIS.					
CO4	To study about the introduction to GIS concepts and GIS softwares					
CO5	To know about the INDUSTRIAL APPLICATIONS AND ECONOMIC ASSESSMENT OF AOTs .					
Mapping of Course Outcomes with 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		M		H	L
	CO2	H			M	L
	CO3	H			M	L
	CO4	H			M	L
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 APPLICATIONS9

Management and monitoring of environment, conservation of resources, coastal zone management – limitations

Total Periods : 45**REFERENCES:**

- 1.Lillesand, T.M. and Kiefer, R.W., Remote Sensing and image interpretation, John Wiley and Sons, New York,2004.
- 2.Burrough,P.A.and McDonnell, R.A., Principles of Geographic information systems, Oxford University press, New York,2001.
- 3.Linz. andSimonet, Remote Sensing of Environment, Addison Wesley publishing Company, New Jersey,1998.

MER054	ECOLOGICAL ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental studies				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					

To educate the students on the principles of ecology as applied to environmental engineering						
COURSE OUTCOMES (COs)						
CO1	To make them understand the introduction to Ecology and Ecological Engineering and its application in all other fields.					
CO2	To understand about the Principles, components and characteristics of Systems approach in Ecological Engineering					
CO3	To understand in detail about the Ecological Engineering Processes anddetermination of sustainable loading of ecosystems					
CO4	To improve the knowledge on the emerging trends of ecotechnology for waste treatment and also the applications of ecological engineering for marine systems					
CO5	To know about the case studies of integrated ecological engineering systems and their commercial prospects.					
Mapping of Course Outcomes with 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		M		H	L
	CO2	H			M	L
	CO3	H			M	L
	CO4	H			M	L
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

Total Periods : 45

REFERENCES:

1	COs/Pos	a	b	c	d	e
2	CO1		H		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Total Periods : 45

REFERENCES:

- 1.Randall J. Charbeneau, “Ground water Hydraulics and Pollutant transport “ Prentice Hall,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

MER056	ENVIRONMETAL BIOTECHNOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering I				

		Course Designed by : Department of Civil Engineering				
OBJECTIVES						
To educate the students on the principles and application of biotechnology in environmental engineering with special reference to waste treatment.						
COURSE OUTCOMES (COs)						
CO1	To make them understand the of principles and concepts of environmental biotechnology					
CO2	To understand about the concept of Environmental biotechnology and its detoxification methods , biotransformation of metals					
CO3	To understand in detail about the microbial technology for waste treatment and the biotechnological remedies for environmental pollution					
CO4	To improve the knowledge on the emerging trends ofRecombinant DNA Technology and its application in genetic engineering					
CO5	To know about the environmental effects,patents and ethics of microbial technology which includes the safe use of animals in EBT.					
Mapping of Course Outcomes with 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			L	M	H
	CO2		M	L		H
	CO3		H		M	L
	CO4		M	L	H	
	CO5		L		H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		

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

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-IV RECOMBINANT DNA TECHNOLOGY AND GENETIC APPLICATION

9

Concept of rDNA technology – expression vectors – cloning of DNA –mutation – construction of microbial strains, radioactive probes , protoplast fusion technology- applications.

UNIT-V ETHICAL AND REGULATORY ISSUES

9

Environmental effects and ethics of microbial technology – safety of genetically engineered organisms – microbial containment – Risk assessment, IPR- patents.

Total Periods : 45

REFERENCES:

1. Chaudhury, G.R. "Biological degradation and Bioremediation of toxic chemicals" Dioscorides press, Oregon, 1994.
2. Martin A.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.

MER057	MEMBRANE SEPARATION FOR WATER AND WASTEWATER TREATMENT			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite:Environmental Engineering I						
	Course Designed by : Department of Civil Engineering						
OBJECTIVES							
To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.							
COURSE OUTCOMES (COs)							
CO1	To make them understand the of principles and concepts of membrane filtration processes						
CO2	To understand about the concept of different membrane systems and their Economics						
CO3	To understand in detail about the membrane bioreactors and the design principles						
CO4	To improve the knowledge on the pretreatment systems and membrane fouling						
CO5	To know about the Case studies on the design of membrane based water and wastewater treatment 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			L	M	H	
	CO2		M	L		H	
	CO3		H		M	L	
	CO4		M	L	H		
	CO5		L		H	M	

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

UNIT 1 MEMBRANE FILTRATION PROCESSES

10

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

UNIT II MEMBRANE SYSTEMS

10

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

UNIT III 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

UNIT IV PRETREATMENT SYSTEMS

8

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

8

Case studies on the design of membrane based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

TOTAL : 45 PERIODS

MER058	INDOOR AIR QUALITY				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:Air &Noise Pollution							
	Course Designed by : Department of Civil Engineering							
OBJECTIVES								
To educate the students on air pollution and control in the indoor environment.								
COURSE OUTCOMES (COs)								
CO1	To make them understand the fundamentals of Design and operation of buildings for improvements of public health associated with indoor air quality.							
CO2	To understand about the air pollutants in indoor environments and its characteristics, consequences							
CO3	To understand in detail about the classification and control of pollutants and case studies associated with it.							
CO4	To improve the knowledge on the Concepts and tools in indoor air quality along with the statistical models associated with it.							
CO5	To know about the basics of the Indoor air pollution from outdoor 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	a	b	c	d	e		
2	CO1		H		L	M		
	CO2		M		H	L		

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

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, schools and 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.

Total Periods : 45

MER059	LANDFILL ENGINEERING AND REMEDIATION TECHNOLOGY				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:Environmental Engineering I,II							
	Course Designed by : Department of Civil Engineering							
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)								
CO1		To understand about the fundamentals of landfill basics and the Legal framework for landfilling						
CO2		To understand about the landfill liners and the cover systems and their design						
CO3		To understand in detail about leachate and landfill gas generation, Design of Landfill gas collection and removal systems						
CO4		To improve the knowledge on Landfill Construction and Operational Controls						
CO5		To know about the contaminated site remediation, Audits of landfill environmental performance and 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		
2	CO1		H		L	M		
	CO2		M		H	L		
	CO3	H			L	M		

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

UNIT I LANDFILL BASICS

8

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

10

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

8

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

10

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

TOTAL: 45 PERIODS

REFERENCES:

1. Robert M. Koerner and Donald H Gray "Geotechnical aspects of Landfill Design and Construction", Prentice Hall, New Jersey.2002

2. Neal Bolton P.E “The Handbook of Landfill Operations”, Blue Ridge Services Inc., Atascadero, CA – ISBN 0-9646956-0-x, 1995
3. 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 Society of Civil Engineers, ASCE Press.2007
4. Donald L Wise and Debra J Trantolo, “Remediation of Hazardous Waste Contaminated Soils, Marcel Dekker Inc., New York,1994
5. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
6. Hari D Sharma and Krishna R. Reddy, Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, John Wiley, New Jersey, 2004
7. Oweis, I.S. and Khera, R.P *Geotechnology of Waste Management*, 2nd Edition, PWS Publishing Co., Boston, MA, 1998

MER060	ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering I				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES To make them understand the fundamentals of environmental law and its relation with other disciplines of law					
COURSE OUTCOMES (COs)					
CO1	To understand about basics of Indian Constitution and Environment and about various pollution control policies				
CO2	To understand about basics of Indian Constitution and Environment and about various pollution control policies				
CO3	To understand in detail about the Administrative regulation –India and to learn about the constitution of various state Pollution control boards				
CO4	To improve the knowledge on the various Pollution Control Laws and its amendments				
CO5	To know about the relevant notifications in environmental (protection) act 1986 and				

	their amendments in the subsequent years					
Mapping of Course Outcomes with 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	L	H		M	
	CO2		H	L		M
	CO3	M		H		L
	CO4	H		L		M
	CO5		M	L		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 policies-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 ADMINISTRATIVE 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-IV POLLUTION 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

Total Periods : 45

REFERENCES:

- 1.Constitution of India Esastern Book Company Lucknow 12 thEdn. 1997.
- 2.onstitutional Law of India- J.N.Pandey 1997 (31 stEdn.) 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.

MER061	ENVIRONMENTAL ENGINEERING STRUCTURES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Design and Drawing –I				

		Course Designed by : Department of Civil Engineering				
OBJECTIVES						
To make them understand the fundamentals of Structural design and their application in Environmental Engineering						
COURSE OUTCOMES (COs)						
CO1	To make them understand the fundamentals of Structural design of Concrete Prestressed Concrete, Steel and Castironetc					
CO2	To understand about the methods of analysis and design of water tanks and the types of cement roofing system					
CO3	To understand in detail about the design of special purpose structures like underground reservoirs and swimming pools					
CO4	To improve the knowledge on the repair and rehabilitation of structures and also diagnosing and identification of the cause and damage,.					
CO5	To know about the exposure on steel, lattice structures used in water and sewerage 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		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I 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 - selection of materials of construction.

UNIT-IV REPAIR AND REHABILITATION OF STRUCTURES**9**

Diagonising the cause and 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 Steel, Lattice Structures used in Water and Sewerage Works**9**

Exposure on Steel, Lattice Structures used in Water and Sewerage Works

Total Periods : 45**TEXT BOOKS:**

- 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.

REFERENCES:

1.Hulse R., and Mosley, W.H., "Reinforced Concrete Design by Computer", Macmillan Education Ltd., 1986.

2.Ramaswamy, G.S., "Design and Construction of Concrete shell roofs", CBS Publishers, India, 1986.

3.Green, J.K. and Perkins, P.H., "Concrete liquid retaining structures", Applied Science Publishers, 1981.

MER062	MASS TRANSFER IN AIR-WATER-SOIL INTERACTION				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:Applied Mechanics							
	Course Designed by : Department of Civil Engineering							
OBJECTIVES								
To educate the students on the mechanism of material transfer between environmental components - air, water and soil								
COURSE OUTCOMES (COs)								
CO1		To make them understand the fundamentals and occurrences of chemical equilibrium and thermal equilibrium at environmental interfaces						
CO2		To understand about the mass transfer theories and mass transfer coefficients along with environment fundamentals of heat transfer						
CO3		To understand in detail about the exchange rates between air and water and also the water interface of lakes and oceans						
CO4		To improve the knowledge on the exchange rates between water and the earth material						
CO5		To know about the basics of the exchange rates between air and soil and to study about the turbulence above the air - soil interface						
Mapping of Course Outcomes with 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	M			L		
	CO2		M	L		H		
	CO3		M	L		H		

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

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 enviro1mental 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 EARTHEN MATERIAL

9

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 earthen material.

Total Periods : 45

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.

MER063	MARINE POLLUTION MONITORING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Coastal Engineering				
	Course Designed by : Department of Civil Engineering				
OBJECTIVES					
To educate the students on aspects of marine pollution and methods of water quality assessment and marine pollution control					
COURSE OUTCOMES (COs)					
CO1	To make them understand the fundamentals of General features of oceans and principles of marine geology				
CO2	To understand about the Living resources in and around the oceans				
CO3	To understand in detail about the planning and preparation of marine Surveying and sea surveying which includes the oceanographic instrumentation				
CO4	To improve the knowledge on the emerging trends of marine pollution applications of				

		remote sensing and GIS in marine studies				
CO5		To know about the control strategies of marine pollution associated with sustainable development				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L	H		M	
	CO2		H	L		M
	CO3	M		H		L
	CO4	H		L		M
	CO5		M	L		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 bed 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.

Total Periods : 45

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.

MER064	UNIT OPERATIONS AND UNIT PROCESSES IN ENVIRONMENTAL TECHNOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Environmental Engineering-I,II				

		Course Designed by : Department of Civil Engineering				
OBJECTIVES						
To conduct laboratory studies on water and wastewater treatment units.						
COURSE OUTCOMES (COs)						
CO1		To Know about selection of unit operations and unit processes.				
CO2		To Know the principles of sedimentation and flotation processes .				
CO3		Having a deep knowledge about the filtration processes and filter media.				
CO4		To understand chemical unit processes and disinfection methods.				
CO5		Having a sound knowledge in the biological treatment 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		L	M	
	CO2	H		L	M	
	CO3	H		L	M	
	CO4	H		L	M	
	CO5	H		L	M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 settling – Removal ratio – Clarifier-thickener- Flotation - 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 BIOLOGICAL UNIT 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.

MER065	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Environmental Engineering-II				
	Course Designed by : Department of Civil Engineering				
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)					
CO1	To make them understand the basics of EIA and its limitations across sectoral issues in terms of references in EIA. It also includes the study of participation of Public and Non-Governmental Organizations in environmental decision making.				
CO2	To understand about the methods and components of EIA and to learn about the exposure systems.				
CO3	To understand in detail about the prediction tools for EIA along with the mathematical				

		modeling for impact prediction.				
CO4	To improve the knowledge on the ethical and quality aspects of Environmental Impact Assessment.					
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.					
Mapping of Course Outcomes with 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		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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-VCASE STUDIES 9

Case studies related to the following sectors-Infrastructure-Mining-industrial-Thermal Power – River valley and Hydroelectric-Nuclear Power.

Total Periods : 45

REFERENCES:

- 1.Lawrence, D.P., Environmental Impact Assesment - Practical solutions to recurrent 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, II and III. The World Bank, Washington,1991.

MER066	ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Industrial Waste Treatment and Disposal				
	Course Designed by : Department of Civil Engineering				

OBJECTIVES						
To educate the students on principles related to Environment, Health and Safety systems in work places, occupational health and hygiene.						
COURSE OUTCOMES (COs)						
CO1	To make them understand the Need for developing Environment, Health and Safety systems in work places					
CO2	To understand about the occupational health and hygiene					
CO3	To understand in detail about the workplace safety and safety systems					
CO4	To improve the knowledge on Elements of a health and safety policy and methods of its effective implementation					
CO5	To know about the Principles and methods of effective training in Environment, Health and Safety systems in work places					
Mapping of Course Outcomes with 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			L	M	H
	CO2		M	L		H
	CO3		H		M	L
	CO4		M	L	H	
	CO5		L		H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

TOTAL : 45 PERIODS**REFERENCES**

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
3. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

MER067	ADVANCED OXIDATION PROCESS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Environmental Engineering I,II				
	Course Designed by : Department of Civil Engineering				

OBJECTIVES						
To educate the students on the principles of various oxidation process needed for waste water treatment						
COURSE OUTCOMES (COs)						
CO1	To make them understand the fundamentals of AOPs for water and wastewater treatment					
CO2	To understand about the various heterogeneous photocatalytic processes					
CO3	To understand in detail about the homogeneous photocatalytic processes					
CO4	To improve the knowledge on the various case studies and applications of semiconductor photolysis					
CO5	To know about the industrial applications and economic assessment of AOTS					
Mapping of Course Outcomes with 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		L	M
	CO2		M		H	L
	CO3	H			L	M
	CO4		M		L	H
	CO5		H		L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

10

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

8

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 AND ECONOMIC ASSESSMENT OF AOTs

10

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.

TOTAL: 45 PERIODS

REFERENCES:

1. Cao G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
2. Rose R. M., Shepard L. A. and Wulff J., "The Structure and Properties of Materials", Wiley EasternLtd,

3. Simon Parsons, "Advanced oxidation processes for water and wastewater treatment", IWA Publishing, 2004

4. Thomas Oppenländer, "Photochemical Purification of Water and Air: Advanced Oxidation Processes (AOPs): Principles, Reaction Mechanisms, Reactor Concepts", Wiley-VCH Publishing, Published by, 2003

5. Marta.I.Litter, RobertsJ.Candal,J.Martin Meichtry,"Advanced Oxidation Technologies: Sustainable Solution for Environmental Treatment , CRC,Press, 2014.

MER068	RESEARCH METHODOLOGY				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Professional Courses							
	Course Designed by : Department of Civil Engineering							
OBJECTIVES								
- To Get adequate knowledge about research concepts - To describe mathematical modeling and simulation - To understand experimental modeling - To get knowledge about the interpretation of result								
COURSE OUTCOMES (COs)								
CO1		To describe research concepts.						
CO2		To Get adequate knowledge about mathematical modeling						
CO3		To describe experimental modeling						
CO4		To understand analysis of results						
CO5		To know about report writing						
Mapping of Course Outcomes with 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	M	L	M	M		

	CO2	H	M	L	M	M
	CO3	H	M		M	M
	CO4	H	M	L	M	M
	CO5	H	M		M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

I. RESEARCH CONCEPTS

9

II. Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

II MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

III EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of

response surface, determining optimum combination of factors, Taguchi approach to parameter design.

IV ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

V REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CHOICE BASED CREDIT SYSTEM
M.TECH- GEOTECHNICAL ENGINEERING
(FULL TIME)
I – IV SEMESTERS

SEMESTER-I							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1	PM	MMA101	Advanced Mathematical Methods	4	0	0	4
2	PC	MGT101	Soil Properties and Behavior	3	0	0	3
3	PC	MGT102	Strength and Deformation Behavior of Soils	3	0	0	3
4	PC	MGT103	Subsurface Investigation and Instrumentation	3	0	0	3
5	PC	MGT104	Soil Dynamics	4	0	0	4
6	PE	MGTE01	Elective I	3	0	0	3
			Total	20	0	0	20

SEMESTER-II							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1.	PC	MGT201	Shallow Foundations	3	0	0	3
2.	PC	MGT202	Deep Foundations	3	0	0	3
3.	PC	MGT203	Ground Improvement Techniques	3	0	0	3
4.	PC	MGT204	Finite Element Method	3	0	0	3
5.	PE	MGTE02	Elective II	3	0	0	3
6.	PE	MGTE03	Elective III	3	0	0	3
Practical							
7	EEC	MGT2L1	Advanced Soil Mechanics Laboratory - I	0	0	4	2
			Total	18	0	4	20

SEMESTER-III							
S.No	Category	Code	Subject Name	L	T	P	C
1	PE	MGTE04	Elective IV	3	0	0	3
2	PE	MGTE05	Elective V	3	0	0	3
	Practical						
3.	EEC	MGT3L1	Advanced Soil Mechanics Laboratory - II	0	0	4	2
4.	EEC	MGT3L2	Computer Applications in Geotechnical Engineering	0	0	2	1
5.	EEC	MGT3L3	Practical Training (4 weeks – During vacation after II semester)	-	-	-	2
6.	EEC	MGT3P1	Project Work(Phase-I)	0	0	12	6
			Total	6	0	18	17

SEMESTER- IV

S.No	Category	Code	Subject Name	L	T	P	C
1	EEC	MGT4P1	Project Work Phase II	0	0	24	12
			Total	0	0	24	12

Overall Credits for the Programme – 69

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)	4	-	-	-	4	5.79
2	Professional Core (PC)	13	12	-	-	25	36.23
3	Professional Electives (PE)	3	6	6	-	15	21.74
5	Employability Enabled Courses (Practicals)	-	2	5	-	7	10.14
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)			6	12	18	26.08
	Total Credits	20	20	17	12	69	100

LIST OF ELECTIVES

Professional Electives (PE-I)

S.No	Code	Subject Name	L	T	P	C
1	MGT051	Theoretical Soil Mechanics	3	0	0	3
2	MGT052	Earthquake Resistant Design of Foundations	3	0	0	3
3	MGT053	Earth and Earth Retaining Structures	3	0	0	3

Professional Electives (PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
4	MGT054	Geoenvironmental Engineering	3	0	0	3
5	MGT055	Advance Soil Mechanics	3	0	0	3
6	MGT056	Geosynthetic and Reinforced Soil Structures	3	0	0	3

Professional Electives (PE-III)

Sl.No.	Code	Subject Name	L	T	P	C
7	MGT057	Geotechnical Earthquake Engineering	3	0	0	3
8	MGT058	Geotechnics for Design of Underground Structures	3	0	0	3
9	MGT059	Geology for Geotechnical Applications	3	0	0	3

Professional Electives (PE-IV)

Sl.No.	Code	Subject Name	L	T	P	C
10	MGT060	Mechanics of Unsaturated Soils	3	0	0	3
11	MGT061	Pavement Engineering	3	0	0	3
12	MGT062	Soil Structure Interaction	3	0	0	3

Professional Electives (PE-V)

Sl.No.	Code	Subject Name	L	T	P	C
13	MGT063	Rock Mechanics and Applications	3	0	0	3
14	MGT064	Earth and Rock Fill Dams	3	0	0	3
15	MGT065	Foundation on Expansive Soils	3	0	0	3

Employability Enabled Courses (EEC)

Sl.No.	Category	Subject Name	L	T	P	C
1	EEC	Advanced Soil Mechanics Laboratory - I	0	0	4	2
2	EEC	Advanced Soil Mechanics Laboratory - II	0	0	4	2
3	EEC	Computer Applications in Geotechnical Engineering	0	0	2	1
4	EEC	Practical Training (2 weeks – During vacation after II semester)	-	-	-	1
5	EEC	Project Work(Phase-I)	0	0	12	6
6	EEC	Project Work Phase II	0	0	24	12

MMA101	ADVANCED MATHEMATICAL METHODS			L	T	P	C
	Total Contact Hours:60			3	2	0	4
	Prerequisite: Numerical Methods						
	Course Designed by :Department of Civil Engineering						
OBJECTIVES To familiarize the students in the field of differential equations to solve bound value problems associated with engineering applications.							
COURSE OUTCOMES (COs)							
CO1	To make them master the techniques of Partial Differential Equations						
CO2	To know about Fourier Transform Techniques						
CO3	To understand about Concept of variation and its properties						
CO4	To know about the Conformal Mapping and Applications						
CO5	To know about Tensor 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					
	CO2	H	L	M			
	CO3	H					
	CO4	H		M			
	CO5	H					

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√				
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

12

Laplace transform: Definitions, properties -Transform of 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

12

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 Poisson's equations.

UNIT III CALCULUS OF VARIATIONS

12

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Problems with constraints – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS

12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications: Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS

12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Innerproduct – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient, divergence and curl.

TOTAL : 60 PERIODS

TEXTBOOKS:

1. Sankara Rao K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 2010
2. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2014
3. Spiegel M.R., "Theory and Problems of Complex Variables and its Application" (Schaum's Outline Series), McGraw Hill Book Co., Singapore, 1981.
4. Ramanaiah, G.T., "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.
5. James G., "Advanced Modern Engineering Mathematics", Pearson Education, Third Edition, 2004.
6. O'Neil P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Fortieth Edition, 2007
2. Andrew L.C. and Shivamoggi B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. Elsgolts L., "Differential Equations and the Calculus of Variations", MIR Publishers, Moscow, 1973.
4. Mathews J.H. and Howell R.W., "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 1997.
5. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Fortieth Edition, 2007

MGT101	SOIL PROPERTIES AND BEHAVIOUR			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite: Soil Mechanics						
	Course Designed by :Department of Civil Engineering						
OBJECTIVES To impart knowledge on the various factors governing the Engineering beha of soils and the suitability of soils for various Geotechnical Engineering applications.							
COURSE OUTCOMES (COs)							
CO1	To study soil deposit and minerals.						
CO2	To know about the physical and chemical behavior of soils.						
CO3	To analysis the compaction behavior of soils.						
CO4	To study the compressibility, shear strength and permeability behavior of soils						
CO5	To know about the prediction in soil behavior						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low							
1	COs/Pos	a	b	c	d	e	
2	CO1	H	M				
	CO2	M	H				
	CO3	M	H	H			

	CO4	H	H	M		M
	CO5	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL DEPOSITS AND CLAY MINERALS 8

Introduction – formation of soils – different soil deposits and their engineering properties – Genesis of clay minerals – classification and identification – Anion and Cation exchange capacity of clays – specific surface area – bonding in clays.

UNIT II PHYSICAL AND PHYSIO CHEMICAL BEHAVIOUR OF SOILS 9

Physical and physio chemical behaviour of soils – diffused double layer theory – computation of double layer distance – effect of ion concentration, ionic valency, pH, dielectric constant, temperature on double layer – stern layer – attractive and repulsive forces in clays – types of soil water – mechanism of soil – water interactions - soil structure.

UNIT III SWELLING, SHRINKAGE AND COMPACTION BEHAVIOUR OF SOILS 10

Problems associated with swelling and shrinkage behaviour of soils – Causes, consequences and mechanisms – factors influencing swell – shrink characteristics – swell potential – osmotic swell pressure – soil fabric and measurement – sensitivity, thixotrophy of soils – soil suction – soil compaction – factors affecting soil compaction.

UNIT IV COMPRESSIBILITY, SHEAR STRENGTH AND PERMEABILITY BEHAVIOUR OF SOILS 10

Compressibility, shear strength and permeability behaviour of fine and coarse grained soils – mechanisms and factors influencing engineering properties – liquefaction potential – causes and consequences.

UNIT V CONDUCTION PHENOMENA AND PREDICTION OF SOIL BEHAVIOUR 8

Conduction in soils – hydraulic, electrical, chemical and thermal flows in soils – applications - coupled flows – Electro-kinetic process – thermo osmosis - electro osmosis – prediction of engineering behaviour of soils using index properties – empirical equations and their applicability.

TOTAL: 45 PERIODS

REFERENCES:

1. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2006.
2. Mitchell, J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.
3. Yong, R.N. and Warkentin, B.P., Introduction to Soil Behaviour, Macmillan, Limited, London, 1979.
4. Coduto, D.P., Geotechnical Engineering – Principles and practices, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
5. Perloff, W.H. and Baron, W, Soil Mechanics, The Ronal Press Company, 1976.
6. Van Olphen, H., Clay colloid Chemistry, John Wiley, 1996
7. Grim, R.E., Applied Clay Mineralogy, McGraw Hill, New York, 1966.
8. Lambe, T.W. & Whitman, R.V. Soil Mechanics, John Wiley & Sons, New York, 1979.
8. Das, B.M., Principles of Geotechnical Engg, PWS Publishing Comp, Boston, 1998
9. Robert D. Holtz and William D. Kovacs, “An Introducton to Geotechnical Engineering”, Prentice Hall (UK) International, London, 1981.

MGT102	STRENGTH AND DEFORMATION BEHAVIOUR OF SOILS			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite: Soil Mechanics						
	Course Designed by :Department of Civil Engineering						
OBJECTIVES To impart knowledge to characterize stress-strain behavior of soils, the failure criteria and to evaluate the shear strength and compressibility parameters of soils.							
COURSE OUTCOMES (COs)							
CO1	To study the shear strength of cohesionless soils						
CO2	To study the shear strength of cohesive soils						
CO3	To study the failure of soils.						
CO4	To study the modulus of soils						
CO5	To learn about critical state soil mechanics						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low							
1	COs/Pos	a	b	c	d	e	
2	CO1	H	H	M			
	CO2	H	M	H			
	CO3	H	M				
	CO4	H			M		
	CO5	H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SHEAR STRENGTH OF COHESIONLESS SOILS

9

Introduction-Shear strength of soil-cohesion-angle of internal friction-Shear strength of granular soils - Direct shear - Triaxial Testing- Drained and undrained Stress-strain behaviour - Dilation, contraction and critical states - Liquefaction and cyclic mobility of saturated sands. Factors influencing stress – strain characteristics – shear strength.

UNIT II SHEAR STRENGTH OF COHESIVE SOILS

9

Shear strength of NC and OC clays - Stress-strain behaviour - Total stress and effective stress approach - Triaxial testing and stress path plotting - pore pressure parameters of Skempton and Henkel - shear strength of partially saturated clay in terms of stress state variables. Factors influencing stress – strain characteristics – shear strength.

UNIT III FAILURE THEORIES

9

Concepts of yield and failure in soils- Failure theories of Von Mises, Tresca and their extended form, their applicability to soils - Detailed discussion of Mohr - Coulomb failure theory.

UNIT IV CONSTITUTIVE MODEL AND DEFORMATION MODULUS OF SOILS

9

Constitutive law for soil – linear, non linear model- hyperbolic idealisation – Mohr-Columb model- Hardening law-Hardening soil model- Hardening soil model with small strain stiffness- Soft soil - Soft soil model - limitation of all models- Deformation modulus for different type of loadings – Poisson's ratio.

UNIT V CRITICAL STATE SOIL MECHANICS

9

The critical state line- Roscoe's surface- Hvorslev's surface- Behavior of sand- Effects of dilation- Limitations of Taylor model- Elastic and plastic deformation-Camclay critical state model- Modified Camclay model- Parameters for design

TOTAL: 45 PERIODS

REFERENCES:

1. Robert D. Holtz., William D. Kovacs., Thomas C. Sheahan., "An Introduction to Geotechnical Engineering" Dorling Kindersley India pvt. Ltd., Second edition, 2013.

2. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014.
3. .. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.
4. Braja, M. Das. "Advanced soil mechanics", McGraw Hill, 1997.
5. Atkinson J.H. and Bransby P.L. "Introduction to critical state soil mechanics" McGraw Hill, 1978.
6. Lambe, T.W. and Whitman R.V. "Soil Mechanics in S.I. Units John Wiley, 1979.
7. Wood, D.M., "Soil behaviour and Critical State Soil Mechanics", Cambridge University Press, New York, 1990.
8. Graham Barnes, "Soil Mechanics Principles and Practices", Macmillan Press Ltd., London, 2002.
9. Braja, M. Das, "Principles of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, Fifth Edition, 2002.
10. Malcolm D. Bolton, "A guide to soil mechanics", Universities Press (India) Private Ltd., Hyderabad, India, 2003.
- 11.. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.

MGT103	SUBSURFACE INVESTIGATION AND INSTRUMENTATION					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Foundation Engineering								
	Course Designed by :Department of Civil Engineering								
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)									
CO1	To study the different methods of exploration								
CO2	To study the exploration techniques								
CO3	To know about the soil sampling								
CO4	To study the field testing in soil exploration								
CO5	To know about the Instrumentation in soil 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	M			M			
	CO2	H	W	M					
	CO3	H	M						
	CO4	H				M			
	CO5	H	M			M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS 8

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 hole methods.

UNIT II EXPLORATION TECHNIQUES 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 SOIL SAMPLING 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 of samples.

UNIT IV FIELD TESTING IN SOIL EXPLORATION 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, correction and data interpretation of all methods.

UNIT V INSTRUMENTATION 10

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, case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. 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.
2. Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.
3. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.
4. 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.

MGT104	SOIL DYNAMICS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Foundation Engineering							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods								
COURSE OUTCOMES (COs)								
CO1	To study about the theory of vibration.							
CO2	To know about the dynamic soil properties and behavior							
CO3	To learn about the types of Machines and Foundations							
CO4	To study the dynamic analysis of impact type machines							
CO5	To know the influence of vibration and remediation							
Mapping of Course Outcomes with 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					
	CO2	H	H					
	CO3	H	H	H	M			
	CO4	H	H					
	CO5	M	H	H				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	Board of Studies meeting – 23 rd September 2016						

UNIT I THEORY OF VIBRATION**9**

Introduction – Nature of dynamic loads – vibrations of single degree freedom system – free vibrations of spring – mass systems – forced vibrations – viscous damping, Transmissibility – Principles of vibration measuring instruments effect of Transient and Pulsating loads – vibrations of multi degree freedom system.

UNIT II DYNAMIC SOIL PROPERTIES AND BEHAVIOUR**9**

Dynamic stress – strain characteristics – principles of measuring dynamic properties – Laboratory Techniques – Field tests – Factors affecting dynamic properties - Typical values- Dynamic bearing capacity – Dynamic earth pressure.

UNIT III FOUNDATIONS FOR RECIPROCATING MACHINES**9**

Types of Machines and Foundations – General requirements – Modes of vibration of a rigid foundation, block method of analysis – Linear Elastic weightless spring method – Elastic half – space method – Analog models ; Design of Block foundation -- Codal Provisions

UNIT IV FOUNDATION FOR IMPACT AND ROTARY MACHINES**9**

Dynamic analysis of impact type machines – Design of Hammer foundations – use of vibrator Absorbers – design – Codal recommendation. Special consideration for Rotary machines – Design criteria – Loads on Turbo Generator Foundation – method of analysis – Design; Dynamic soil – structure – Interaction, Codal Provisions.

UNIT V INFLUENCE OF VIBRATION AND REMEDIATION**9**

Mechanism of Liquefaction–Influencing factors--Evaluation of Liquefaction potential based on SPT-Force Isolation – Motion Isolation – use of spring and damping materials – vibration control of existing machine foundation – screening of vibration – open trenches – Pile Barriers – salient construction aspects of machine Foundations.

TOTAL: 45 PERIODS**REFERENCES:**

1. Moore, P.J., "Analysis & Design of Foundations for Vibrations", Oxford & IBH, 2006.
2. Krammer S.L., "Geotechnical Earthquake Engineering", Prentice hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
3. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing , New Delhi, 2000. 4. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.
5. Swami Saran, "Soil Dynamics and Machine Foundation", Galgotia publications Pvt. Ltd., New Delhi 1999.
6. Kameswara Rao, "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998.

MGT201	SHALLOW FOUNDATIONS					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Foundation Engineering								
	Course Designed by :Department of Civil Engineering								
OBJECTIVES To impart knowledge to select, analyse, geotechnical and structural design of shallow foundation depending on ground conditions.									
COURSE OUTCOMES (COs)									
CO1	To learn the different type foundation design.								
CO2	To study the bearing capacity of soil.								
CO3	To know about the component of settlement								
CO4	To study the analysis of foundation								
CO5	To study the foundation for special conditions								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	M	M					
	CO2	H							
	CO3	H		H					
	CO4	H	M	H					
	CO5	H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	Board of Studies meeting – 23 rd September 2016							

UNIT I FOUNDATION DESIGN DECISIONS

6

Introduction to International codes-Geotechnical triangle – Geotechnical design triangle – Types of foundation – Types of Shallow foundation, their applicability – Selection of type of foundation – conceptual design principles – General and additional considerations – Depth of foundations – Hostile Environment – holistic approach – circumstances.

UNIT II BEARING CAPACITY

9

Theories of bearing capacity – Ultimate Bearing capacity - Homogeneous - Layered soils – Rocks -

Evaluation of bearing capacity from in-situ tests – Safe bearing capacity – Bearing capacity of foundations in slope – Bearing capacity under eccentric loading – partial safety factor approach – Codal provisions.

UNIT III SETTLEMENT AND ALLOWABLE BEARING PRESSURE 9

Component of settlement – Influence of foundation stiffness approach to settlement computations – immediate, primary and secondary consolidation settlement – stress path method of settlement evaluation – layered soil – construction period correction. Evaluation from in-situ tests – Allowable settlement – Allowable bearing pressure – codal provisions.

UNIT IV INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS 12

Analysis of foundation – isolated – strip – combined footings – Flat raft – Stiffened raft foundations. Conventional – elastic approach – Soil Structure Interaction Principles – Winkler foundation – Elastic half space approach – Structural design of Shallow foundation – Codal provisions.

UNIT V FOUNDATION FOR SPECIAL CONDITIONS 9

Shell foundations – Foundation design in relation to ground movements – Foundation on compressible fills – Foundation for tower – Foundation for earthquake effects – Offshore foundation – Machine foundation – Codal Provisions.

TOTAL: 45 PERIODS

REFERENCES:

1. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014
2. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., "Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II" ICE Publishing, UK., 2012.
3. Karuna Moy Ghosh, "Foundation Design in Practice" PHI learning private Ltd, Delhi, 2009.
4. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., "Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II" ICE Publishing, UK., 2012.
5. Nainan P. Kurian, "Design of Foundation Systems, Principles and Practices, Narosa Publishing House, Third Edition, 2006.
6. Varghese, P.C. "Design of Reinforced Concrete Foundations", Prentice-Hall of India, New Delhi, 2009
7. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014
8. Braja M.Das, "Geotechnical Engineering Handbook" J.Ross Publishing, Cengage Learning India Pvt Ltd, 2010
9. Edward Tsodik, Analysis of Structures on Elastic Foundations, J.Ross Publishing, Cengage Learning India Private limited, Delhi, 2013.
10. Som.N.N., Das.S.C., "Theory and Practice of Foundation Design" PHI learning private Ltd, Delhi, 2013.
11. Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.
12. Swami Saran, "Soil Dynamics and Machine Foundation, Galgottia Publications Pvt. Ltd., New

MGT202	DEEP FOUNDATIONS					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Foundation engineering								
	Course Designed by :Department of Civil Engineering								
OBJECTIVES: The student will be exposed to the design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions.									
COURSE OUTCOMES (COs)									
CO1	To study the pile foundation and classification.								
CO2	To study the axial load of piles and pile groups								
CO3	To learn about the lateral and uplift load capacity of piles								
CO4	To know the structural design of pile and pile groups								
CO5	To study about caissons and its principles.								
Mapping of Course Outcomes with 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	M	M	M					
	CO2	H		H					
	CO3	H	M	H		M			
	CO4	M							
	CO5	M							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	Board of Studies meeting – 23 rd September 2016							

UNIT I PILE CLASSIFICATIONS & LOAD TRANSFER PRINCIPLE**10**

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments and methods – effect of pile installation on soil condition – pile raft system – basic interactive analysis - criteria for pile socketing - responsibility of engineer and

contractor.

UNIT II AXIAL LOAD CAPACITY PILES AND PILE GROUPS 10

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results – pile integrity test -Settlement of piles and pile group - codal provisions and IRC guide lines.

UNIT III LATERAL AND UPLIFT LOAD CAPACITY OF PILES 10

Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out load tests – codal provision – IRC guide lines – case studies.

UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS 9

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps — pile subjected to vibration – codal provision – IRC guide line.

UNIT V CAISSONS 6

Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences - codal provision.

TOTAL: 45 PERIODS

REFERENCES:

1. Varghese P.C.,” Design of Reinforced Concrete Foundations”, PHI Learning Private Limited, New Delhi, 2009.
2. Varghese P.C.,” Foundation Engineering”, PHI Learning Private Limited, New Delhi, 2005.
3. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.
4. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
5. Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.
4. Michael Tomlinson and John Woodward, Pile design and construction practice, Taylor & Francis Group, London & New York, 2008.
6. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995. 6.
- Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1996.
7. Donald, P., Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.
8. Varghese P.C.,” Foundation Engineering”, PHI Learning Private Limited, New Delhi, 2005.

MGT203	GROUND IMPROVEMENT TECHNIQUES					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Building Construction								
	Course Designed by :Department of Civil Engineering								
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 design techniques required to implement various ground improvement methods.									
COURSE OUTCOMES (COs)									
CO1	To learn the Scope and necessity of ground improvement.								
CO2	To study the compaction and sand drains								
CO3	To know about the stone column, lime piles and soil nailing								
CO4	To study the geosynthetics and its applications								
CO5	To have a clear understanding about the grouting method.								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	M						
	CO2	M	M		M	M			
	CO3	H		H					
	CO4	H	M						
	CO5	H							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	Board of Studies meeting – 23 rd September 2016							

UNIT I DEWATERING

9

Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.

UNIT II COMPACTION AND SAND DRAINS

9

Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand

piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.

UNIT III STONE COLUMN, LIME PILES AND SOIL NAILING 9

Stone column with and without encased, lime piles – Functions – Methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.

UNIT IV GEOSYNTHETICS AND ITS APPLICATIONS 9

Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

UNIT V GROUTING 9

Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. Pappala, A.J., Huang, J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
2. Cox, B.R., and Griffiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010.
3. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
4. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
5. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.
6. Moseley, M.P., Ground Treatment, Blackie Academic and Professionals, 1998.
7. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
8. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
9. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
10. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.
11. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.

MGT204	FINITE ELEMENT METHODS	L	T	P	C
	Total Contact Hours:60	3	0	0	3
	Prerequisite: Structural Analysis-II				

		Course Designed by :Department of Civil Engineering				
OBJECTIVES: Students are focused on acquiring the basic knowledge and computational skills in terms of finite element formulation with respect to various kinds of Geotechnical Engineering problems.						
COURSE OUTCOMES (COs)						
CO1		To analysis the basic concepts in structures.				
CO2		To determine displacement models				
CO3		To design the isoperimetric formulation				
CO4		To learn the geotechnical consideration				
CO5		To know the application in geotechnical 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	H		
	CO2	H	H	H		M
	CO3	H	H	H		
	CO4	M	H	M		
	CO5	H	H	M		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC CONCEPTS

9

Introduction – basic concepts - discretization of continuum, typical elements, the element characteristic matrix, element assembly and solution for unknowns – applications. Variational principles, variational formulation of boundary value problems, variational methods of approximation such as Ritz and weighted residual (Galerkin) methods.

UNIT II DISPLACEMENT MODELS

9

Displacement based elements - element equations, convergence requirements, shape functions – element stresses and strains – element stiffness matrix - global equations – boundary conditions – solution of global equations – finite elements for axi-symmetric problem – one dimensional problem of

stresses and strains – finite element analysis for two – dimensional problems.

UNIT III ISOPARAMETRIC FORMULATION

8

Isoparametric element - Local and Natural Co-ordinates systems, Line, Triangular, Quadrilateral and Tetrahedral Element-Interpolation - Displacement Models Formulation of Isoparametric - Finite element matrices in Local and Global Coordinate system – refined elements – numerical integration techniques.

UNIT IV GEOTECHNICAL CONSIDERATION

9

Introduction – total stress analysis – pore pressure calculation – FEM to model structural components, strain definitions, constitutive equation, finite element formulation, membrane elements – Finite elements to model interfaces – basic theory – finite element formulation – boundary conditions – finite element theory for nonlinear behavior of soils.

UNIT V APPLICATION IN GEOTECHNICAL ENGINEERING

10

Use of FEM to problems in soils – description and application to consolidation – seepage - FEM to simulate soil – structure interaction problems – software package use for simulating and analyzing the real foundation problem using FEM such as footing, pile foundation and deep excavations.

TOTAL: 45 PERIODS

REFERENCES:

1. Programming the Finite Element Method with application to Geomechanics by Smith, I.M., John Wiley and Sons, New Delhi, 2000.
2. Introduction to the finite element method by Desai and Abel, Van Nostrand Reinhold Company, New York, 1972.
3. Finite element analysis Theory and Programming by Krishnamoorthy.C.S., Tata McGraw-Hill, New Delhi, 1990.
4. Finite element in geotechnical engineering by Naylor, Pande, Simpson and Tabb., Pineridge Press Ltd, Swansea, U. K, 1981.
5. The Finite Element Method by Zienkiewicz, O.C., 3rd Edition, Tata McGraw-Hill publishing Co., New Delhi, 1983.
6. Finite element analysis in geotechnical engineering – theory by Potts, D.M. and Zdravkovic, L., Published by Thomas Telford, London, 1999.
7. An introduction to the finite element method by Reddy, J.N., McGraw Hill, New York, 1984.
8. The Finite Element Methods in Engineering by Rao, S.S., Pergamon, New York, 1998.
9. Soil-machine introduction – A finite element perspective by Shen, J. and Kushwahs, R.L., Moral Dikker, Inc., 1998.
10. Concepts and applications of finite element analysis by Cook, R.D., Malkus, D.S., and Plesha, M.E., John Wiley, New York., 1989.

MGT2L1	ADVANCED SOIL MECHANICS LABORATORY - I				L	T	P	C
	Total Contact Hours:45				0	0	4	2
	Prerequisite: Soil Mechanics Lab							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES At the end of the course student attains adequate knowledge in assessing index properties, compaction, CBR, Compressibility, Swell characteristics and permeability of soils by conducting laboratory tests.								
COURSE OUTCOMES (COs)								
CO1	To carries out index test on soil							
CO2	To analysis the chemical tests on soil.							
CO3	To solve practical problems related compaction and cbr tests on soil							
CO4	To study the consolidation and permeability tests							
CO5	To determine the of percent swell							
Mapping of Course Outcomes with 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						
	CO2	M						
	CO3	M	M	H		M		
	CO4	H		H				
	CO5	M						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	Board of Studies meeting – 23 rd September 2016						

LIST OF EXPERIMENTS

UNIT I INDEX TESTS

12

Specific gravity of soil solids-Grain size distribution (Sieve analysis and Hydrometer analysis) - Liquid limit and Plastic limit tests - Shrinkage limit and Differential free swell tests - Field density Test

UNIT II CHEMICAL TESTS

12

Chemical analysis – pH – Conductivity – quantification ions through flame Photometer of Determination of organic, sulphate and chlorite content.

UNIT III COMPACTION AND CBR TESTS**12**

Compaction tests - Determination of moisture – density relationship – Influence of compaction energy – CBR Test.

UNIT IV COSOLIDATION AND PERMEABILITY TESTS**12**

One dimensional

consolidation test, C_v , C_c and m_v determination. Permeability of soil – constant and falling head methods.

UNIT V SWELL TESTS**12**

Determination of percent swell – swell pressure, constant volume method; expanded - loaded method.

TOTAL: 60 PERIODS**REFERENCES:**

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, New Delhi, 2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London 1990.
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.
6. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin, 1997
7. Al-Khatiji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
8. “Soil Engineering Laboratory Instruction Manual”, Published by the Engineering College Cooperative Society, Chennai, 1996.
9. Lambe T.W., Soil Testing for Engineers”, John Wiley and Sons, New York, 1990.
10. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

MGT3L1	ADVANCED SOIL MECHANICS LABORATORY -II	L	T	P	C
	Total Contact Hours:60	0	0	4	2
	Prerequisite: Soil Engineering Laboratory-I				
	Course Designed by :Department of Civil Engineering				
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 gain knowledge in assessing the properties of soils through field tests and also by conducting model tests.					
COURSE OUTCOMES (COs)					
CO1	To estimate the stresses under any system of foundation loads				
CO2	To solve Soil water characteristic problems				

triaxial test (demonstration only).

TOTAL: 60PERIODS

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, London 1990.
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. Kameswara Rao, 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-Khatiji, 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 to time.

MGT3L2	COMPUTER APPLICATIONS IN GEOTECHNICAL ENGINEERING				L	T	P	C
	Total Contact Hours:30				0	0	2	1
	Prerequisite: Computer Aided Building Drawing							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.								
COURSE OUTCOMES (COs)								
CO1	Have a fundamental knowledge of the design of irrigation structures.							
CO2	To study about drawing such as Foundations, Retaining walls, and Ground improvement							
CO3	To learn about design and Drawing for deep foundation							
CO4	Have a fundamental knowledge of the design embankment or surcharge adjacent to an existing structure which can describe real life phenomena							
CO5	To analysis the structure using 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		

CO2	To study the stress and displacement					
CO3	To study the theory of plasticity					
CO4	To study the Stability of Soil Structure					
CO5	To study the Steady state condition of porous media					
Mapping of Course Outcomes with 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	M	H			
	CO3	M	H	M		M
	CO4	H	M			
	CO5	H	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I THEORY OF ELASTICITY

12

Material behavior – Basic Concepts – Elastic, Viscous and Plastic 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 polar co-ordinates.

UNIT II STRESS AND DISPLACEMENT IN ELASTIC – HALF SPACE MEDIUM

14

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 – Burmister method.

UNIT III THEOREMS OF PLASTIC COLLAPSE AND THEIR APPLICATIONS

10

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 and cuts.

UNIT IV STABILITY OF SOIL STRUCTURE BY SLIP LINE METHOD AND LIMIT EQUILIBRIUM ANALYSIS 14

Introduction – stress – strain relationship in a perfectly plastic material – discontinuous slipping – stress and displacement field calculations – associated field calculation – Slip line solutions for undrained and drained conditions – limit equilibrium solutions for stability of foundation, retaining walls and slopes.

UNIT V FLOW THROUGH POROUS MEDIA 10

Flow through porous media – Darcy's law – General equation of flow, seepage through isotropic anisotropic and non-homogeneous conditions – Steady state condition, confined and unconfined flow – solution by flow net – seepage pressure – piping.

TOTAL : 60 PERIODS

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; The 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), Ernst & Sohn, 2002.
7. Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons, Inc., Network, 2000.
8. Cedergren, H.R., Seepage, Drainage and Flownets, John Wiley, 1997.
9. Davis, R.O and Selvadurai, A.P.S., Elasticity and Geomechanics, Cambridge University Press, 1996.
10. Wai-Fah Chen, and Liu, X.L., Limit Analysis in Soil Mechanics, Elsevier Science Ltd., 1991.
11. Atkinson, J.H., Foundations and Slopes, McGraw Hill, 1981.

MGT052	EARTHQUAKE RESISTANT DESIGN OF FOUNDATIONS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Foundation engineering				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES Focus is mainly on identifying the different kinds of loading induced on the foundation due to earthquake and soil - foundation interaction analysis with					

reference to various design parameters that including liquefaction of soil due to earthquake.						
COURSE OUTCOMES (COs)						
CO1	To study the basic design parameters of soil					
CO2	To study the behavior of shallow foundation					
CO3	To study the Earthquake loading on deep foundation					
CO4	To study the seismic design of retaining wall					
CO5	To study the structural design of foundation					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	M	H		M
	CO2	M	H	M		
	CO3	H	H	H		M
	CO4	M	M	H		
	CO5	H	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC DESIGN PARAMETERS

9

Dynamic properties of soils and its evaluation, strength and deformation characteristics of soils under earthquake loading, liquefaction hazard evaluations and remedial measures, geotechnical failure of foundations during earthquake, provision of IS 1893 and IS 13920

UNIT II SHALLOW FOUNDATION

9

Design requirements – bearing capacity theory under earthquake loading – bearing capacity analysis for liquefied soil – bearing capacity analysis for cohesive and cohesionless soils - seismic settlement of foundation.

UNIT III DEEP FOUNDATION

10

Earthquake loading – inertial and kinematic loading - performance of piles during earthquake loading

– theories of pile failure in liquefiable soils – failure based on bending mechanism/buckling instability – methods of analysis – force based or limit equilibrium method – p-y method – pile settlement - guidelines for designing of piles under kinematic loading due to liquefaction – seismic design of well/cassion foundations.

UNIT IV SEISMIC DESIGN OF RETAINING WALL

9

Introduction – Seismic passive lateral earth pressure, behaviour of retaining wall during earthquakes, modification of Coulomb's Theory, Modified Culmann's Theory, displacement analysis, Indian standard code of practice.

UNIT V STRUCTURAL DESIGN OF FOUNDATION

General requirements of machine foundations – Design criteria – principles of & simple procedures of design of foundations for machineries – loads acting on foundations during earthquake – fundamental failure mechanisms of foundations – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.

TOTAL: 45 PERIODS

REFERENCES:

1. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett and Stuart Haigh, Imperial College Press, London WC2H 9HE, 2010.
2. Geotechnical Earthquake Engineering by Day R. W., handbook, McGraw – Hill, New York, 2002..
3. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett and Stuart Haigh, Imperial College Press, London WC2H 9HE, 2010.
4. Basic geotechnical earthquake engineering by Kamalesh Kumar, New Age International Publishers, New Delhi, 2008.
5. Design of foundation in seismic areas: Principles and some applications by Bhattacharya S. (eds), Published by NICEE [National Centre for Earthquake Engineering (India)]. ISBN: 81-904190 1-3, 2007
6. Pile foundation analysis and design by Poulos H.G. and Davis E.H., John Wiley and Sons, 1980.
7. Soil dynamics by Prakash, S., McGraw Hill, New York, 1981.
8. Geotechnical Earthquake Engineering by Steven L. Kramer, Prentice Hall, New Delhi, 1996.
9. Foundation design and construction by Tomlinson M.J., Longman Scientific & Technical, England, 1986.
10. Soil Mechanics in Engineering Practice by Terzaghi and Peck, R. B, John Wiley & Sons, New York, 1967.

MGT053	EARTH AND EARTH RETAINING STRUCTURES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Engineering Earth Science				

		Course Designed by :Department of Civil Engineering				
OBJECTIVES At the end of this course, students are expected to analyze and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.						
COURSE OUTCOMES (COs)						
CO1		To study the earth pressure theories				
CO2		To determine stability of retaining structures				
CO3		To study the behavior of sheet pile walls				
CO4		To study the supported excavations				
CO5		To study the behavior of stability of slopes				
Mapping of Course Outcomes with 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	M	M			
	CO2	M		H		M
	CO3	H	M	H		
	CO4	H				M
	CO5	M	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I EARTH PRESSURE THEORIES

10

Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.

UNIT II COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES 8

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

UNIT III SHEET PILE WALLS

8

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.

UNIT IV SUPPORTED EXCAVATIONS

9

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts - Slurry Supported Trenches- Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.

UNIT V STABILITY OF SLOPES

9

Introduction, Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts. Role of geosynthetics in stabilization of slopes.

TOTAL: 45 PERIODS

REFERENCES:

1. . Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.
2. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.
3. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001
4. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.
5. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Book- source, 2000.
6. Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS series in Civil Engineering, 1998.
7. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
8. Day, R.W., Geotechnical and Foundation Engineering: Design and Construction, McGraw Hill, 1999.
9. Mandal, J.N., Reinforced Soil and Geotextiles, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.
10. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
11. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley – Interscience Publication, 1984.
12. Petros P. Xanthakos., Slurry walls as structural systems, McGraw-Hill, Inc., New York, 1994.
13. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow, 1986.

MGT054	GEOENVIRONMENTAL ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Geotechnical engineering				
	Course Designed by :Department of Civil Engineering				

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 thereby protecting environment..						
COURSE OUTCOMES (COs)						
CO1		To study the Environmental laws and regulations				
CO2		To study the Transport of contaminant in subsurface				
CO3		To study the waste containment and remediation of contaminated				
CO4		To study the behavior of landfills				
CO5		To study the stabilisation of waste				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H				
	CO2	M				
	CO3	M		M		M
	CO4	M				
	CO5	H				M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL – WASTE INTERACTION

8

Role of Geoenvironmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure -factors influencing soil-pollutant interaction – modification of index, chemical and engineering properties – physical and physio-chemical mechanisms – Environmental laws and regulations.

UNIT II CONTAMINANT TRANSPORT AND SITE CHARACTERISATION

9

Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatilization, biodegradation – characterization of contaminated sites – soil and rock data – hydrological and chemical data – analysis and evaluation – risk assessment – case studies.

UNIT III WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES

Insitu containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – soil vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, phyto remediation – ground water remediation – pump and treat , Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.

UNIT IV LANDFILLS AND SURFACE IMPOUNDMENTS 9

Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection – final cover design – monitoring landfill.

UNIT V STABILISATION OF WASTE 10

Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization – case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGrawHill, Inc. Singapore, 1994.

MGT055	ADVANCE SOIL MECHANICS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Soil mechanics				

		Course Designed by :Department of Civil Engineering				
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 thereby protecting environment..						
COURSE OUTCOMES (COs)						
CO1		To study the characteristics strength of soil				
CO2		To study the fluid flow for 1-d, 2-d and 3d seepage				
CO3		To study the stresses in soil from surface loads				
CO4		To study the stress-strain relationship of soils				
CO5		To study the geotechnical physical 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
2	CO1	H	M	M		M
	CO2	H	H	H		
	CO3	H	H	H		M
	CO4	H	M	H		
	CO5	M	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL COMPOSITION AND SOIL STRUCTURE

9

Soil formation; - Types of soils and their characteristics- Particle sizes and shapes- their impact on engineering properties; Soil structure; Clay mineralogy; Soil-air-water interaction; Consistency; Soil compaction; Concept of effective stress.

UNIT II PERMEABILITY AND SEEPAGE

9

Permeability; Seepage force and effective stress during seepage. Laplace equations of fluid flow for 1-D, 2-D and 3D seepage, Flow nets, Anisotropic and non-homogeneous medium, Confined and Unconfined seepage.

UNIT III COMPRESSIBILITY AND CONSOLIDATION

9

Stresses in soil from surface loads; Terzaghi's 1-D consolidation theory; Application in different boundary conditions; Ramp loading. Determination of Coefficient of consolidation c_v ; Normally and Overconsolidated soils; Compression curves; Secondary consolidation. Radial consolidation; Settlement of compressible soil layers and Methods for accelerating consolidation settlements.

UNIT IV STRESS-STRAIN RELATIONSHIP AND SHEAR STRENGTH OF SOILS 9

Stress state, Mohr's circle analysis and Pole, Principal stress space, Stress paths in p-q space; Mohr-Coulomb failure criteria and its limitations, correlation with p-q space; Stress-strain behaviour: Isotropic compression and pressure dependency, confined compression, large stress compression, Definition of failure, Interlocking concept and its interpretations, Drainage conditions; Triaxial behaviour, stress state and analysis of UC, UU, CU, CD, and other special tests, Stress paths in triaxial and octahedral plane; Elastic modulus from triaxial tests.

UNIT V GEOTECHNICAL PHYSICAL MODELING 9

Physical modeling methods; Application of centrifuge modeling and its relevance to geotechnical engineering; Centrifuge modeling of geotechnical structures.

REFERENCES:

1. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGrawHill, Inc. Singapore, 1994.

MGT056	GEOSYNTHETIC AND REINFORCED SOIL STRUCTURES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Soil Mechanics				
	Course Designed by :Department of Civil Engineering				
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)					
CO1	To study about the materials used in reinforced soil structures				

CO2	To learn about the design for soil reinforcement and separation					
CO3	To study about the soil reinforcement and separations					
CO4	To learn the concepts of filtration mechanisms and filtration design					
CO5	To learn the functions of reinforcement against slope failure & Stability 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			M
	CO2	H	H	H		M
	CO3	H	H			
	CO4	M	M			
	CO5	M	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT 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 and Geosynthetics interaction

UNIT II REINFORCING MATERIALS AND THEIR 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 properties testing.

UNIT III DESIGN FOR SOIL REINFORCEMENT AND SEPARATION 9

Reinforcing the soil - Geotextiles and Geogrids –Retaining wall – Embankments – Basal reinforcement – piled embankment – unpaved roads – paved roads – railway tracks – Shallow

foundations – seismic aspects.

UNIT IV DESIGN FOR FILTRATION, DRAINAGE AND CONTAINMENT 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 bank protection.

UNIT V DESIGN OF SLOPES 9

Type and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability analysis – Design aspects – Seismic aspects – General construction aspects.

REFERENCES:

1. Sanjay Kumar Shukla., “Handbook of Geosynthetic Engineering” ICE publishing, London., Second edition., 2012
2. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., “Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II” ICE Publishing, UK., 2012.
- 3.. Cheng.Y.M., Lau.C.K., “Slope Stability Analysis and Stabilization” Routledge Taylor & Francis Group, London., 2008.
4. Kerry Rowe.R., “Geotechnical and GeoEnvironmental Engineering handbook” Kluwer Academic Publishers, 2001
5. Muller, W.W. HDPE Geomembranes in Geotechnics, Springer, New York 2007
6. Sivakumar Babu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad, 2006.
7. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
8. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
9. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
10. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.

MGT057	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Dynamics and Seismic Design				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES To understand the dynamics of earth and its response, effect on earth structure and measure so mitigate the effects..					
COURSE OUTCOMES (COs)					
CO1	To learn the mechanism and causes of Earthquakes				
CO2	To learn the principles of vibration measuring instruments effect of Transient and Pulsating loads				
CO3	To learn the concepts of ground motion characteristics				

CO4		To study the concepts of design ground motion and to develop design ground motion				
CO5		To learn about the evaluation of slope stability				
Mapping of Course Outcomes with 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	H		
	CO3	H	H	H		M
	CO4	M	H	H		
	CO5	M	H	H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I ELEMENTS OF EARTHQUAKE SEISMOLOGY

6

Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

UNIT II THEORY OF VIBRATION

9

Introduction – Nature of dynamic loads – vibrations of single degree freedom system – free vibrations of spring – mass systems – forced vibrations – viscous damping, Transmissibility – Principles of vibration measuring instruments effect of Transient and Pulsating loads – vibrations of multi degree freedom system.

UNIT III GROUND MOTION CHARACTERISTICS

10

Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

UNIT IV DESIGN GROUND MOTION

10

Wave propagation Analysis - Site Amplification, Ground Response Analysis - Method of analysis -

One Dimensional Analysis - Equivalent linear Analysis – shear beam Analysis - site effects - Design Ground Motion - Developing Design Ground Motion. Application of software package - code recommendations.

UNIT V SEISMIC STABILITY ANALYSIS

10

Assessment of liquefaction potential based on SPT-N value – permanent settlement – displacement prediction – Mitigation of liquefaction induced damage – Microzonation for intensity – liquefaction – Bearing capacity analysis – Effects of Pile foundation – Response of slopes – Evaluation of slope stability – Pseudostatic – Newmark's study of Block analysis – Dynamic analysis – Earthpressure due to ground shaking – Dynamic analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Ikuo Towhata, "Geotechnical Earthquake Engineering" Springer series in Geomechanics and Geoengineering, Scientific Publishing services Pvt. Ltd., 2008.
2. Wai-Fah Chen and Charles Scawthorn, Earthquake Engineering Hand book, Caspress, 2003
3. Robert W. Day, Geotechnical Earthquake Engineering Hand book, Second Edition, McGraw Hill, 2012.
3. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
4. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
6. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
7. Swami Saran, "Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd., New Delhi-110002, 1999.

MGT058	GEOTECHNICS FOR DESIGN OF UNDERGROUND STRUCTURES	L	T	P	C
	Total Contact Hours:45	0	0	2	1
	Prerequisite: Foundation Engineering				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES Students mainly focused in visualizing and critically analyzing the behavior of underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure on the underground structures.					
COURSE OUTCOMES (COs)					
CO1	To understanding the ground &building response to ground movements				
CO2	To study the stress and deformation analysis of excavation				
CO3	To learn the design of underground supporting systems				
CO4	To learn the design of tunnel				
CO5	To learn about the protection of building using the behavior of excavation and				

	tunneling induced deformation					
Mapping of Course Outcomes with 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	M	H			M
	CO2	H	H	H		
	CO3	H	M	H		H
	CO4	M	M	H	M	
	CO5	M	M			M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I GROUND MOVEMENTS AND ITS EFFECTS

9

Introduction – understanding the ground – Building response to ground movements – concept of limiting tensile strain – strains in simple rectangular beams – ground movement due to tunneling and excavation - lateral supporting systems – retaining walls – factors influencing on the selection of the retaining system – case history.

UNIT II ANALYSIS OF UNDERGROUND SUPPORTING SYSTEMS

9

Introduction - free and fixed earth support method – shear failure of strutted walls – push in – basal heave - upheaval – sand boiling - Stress and deformation analysis of excavation: simplified method – beam on elastic foundation method – finite element method.

UNIT III DESIGN OF UNDERGROUND SUPPORTING SYSTEMS

9

Introduction – principles of retaining wall design – types of wall support systems - design of structural elements – Permanent situations – bottom-up/top-down construction sequences – Props – Tied systems – Soil berms – Design of ground anchors – Retaining wall as part of complete underground structure – resistance to vertical and lateral actions

UNIT IV DESIGN OF TUNNEL

10

Introduction - longitudinal and transverse profile of tunnel structure - tunnel protection against fire - advanced systems of anti-water insulation of underground structures - loading types of shallow and

deep tunnels, rock mass classification - mining technologies of deep excavation - shield technology, execution technology of shallow underground structures, sewerage objects - trenchless technologies.

UNIT V PROTECTION OF ADJACENT BUILDINGS

8

Introduction – protection of building using the behaviour of excavation and tunneling induced deformation – building protection by auxiliary methods – construction defects and remedial measures – building rectification methods.

TOTAL: 45 PERIODS

REFERENCES:

1. Deep Excavation Theory and Practice by Chang – Yu Ou, Taylor & Francis Group, London, UK, 2006.
2. An Introduction to Geotechnical Engineering by Holtz, R.D. and Kovacs, W.D., Prentice – Hall, Inc., Englewood Cliffs, NJ, 1981.
3. Soil Mechanics in Engineering Practice by Terzaghi, K. and Peck, R. B, John Wiley & Sons, New York, 1967.
4. Foundation Engineering by Peck, R. B., Hanson, W.E., and Thornburn, T.H., John Wiley & Sons, New York, 1977.
5. Engineering Principles of Ground Modification by Hausman, M. R., McGraw – Hill Publishing Company, New York, 1990.

MGT059	GEOLOGY FOR GEOTECHNICAL APPLICATIONS				L	T	P	C
	Total Contact Hours:60				3	0	0	3
	Prerequisite: Geotechnical Engineering							
	Course Designed by : Department of Civil Engineering							
OBJECTIVES Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.								
COURSE OUTCOMES (COs)								
CO1	To learn the engineering properties of rocks and minerals							
CO2	To study about the seismic geophysical methods in subsurface geological investigations for foundation engineering							
CO3	To learn about the logging techniques							
CO4	To learn about the preparation of profiles from contour map							
CO5	To study about the ground stability							
Mapping of Course Outcomes with 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					
	CO2	H	H	M				

	CO3	H	H	H		
	CO4	M	M			
	CO5	M	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I ENGINEERING PROPERTIES OF ROCKS AND MINERALS 12

Geology for foundation engineering – Types of rocks, rock description-texture, structure, composition and its relation to quality and strength of rocks, engineering classification of rocks –weathering grade and its significance in engineering site-Engineering properties of rocks - Physical and chemical properties of minerals and its relation to strength and durability of rock. Geotechnical properties of rocks of Tamilnadu.

UNIT II SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS 9

Field investigations - electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, applications of GPR in subsurface strata studies, Description of structural discontinues, Strike and dip of rocks, folds, faults and joints.

UNIT III DRILL HOLE AND CORE LOGGING 8

Logging techniques – Resistivity log, Neutron log, sonic log, gamma log. Rock core logging – rocks description, weathering grade, RMR, RQD and sampling methods for rock strength, and composition studies.

UNIT IV MAPPING TECHNIQUES 8

Preparation of profiles from contour map; lithological and structural mapping of shallow and deep excavated sites. Hand on exercises.

UNIT V GEOLOGICAL INVESTIGATIONS FOR FOUNDATION ENGINEERING 8

Ground stability studies - Scour and erosion studies-stability of slopes and geological solution for slope stability in landslides areas.

TOTAL: 45 PERIODS

REFERENCES:

1. Varghese P.C. Engineering Geology for civil engineers, PHI learning Pvt.Ltd. New Delhi-1, 2012
2. Venkata Reddy. D., Engineering geology, Vikas Publishing Home, Noida, 2010
3. Bell FG. by Engineering Geology, Second Edition, Butterworth-Heinemann, Oxford, 2007
4. Sathya Narayanaswami, Engineering Geology, Dhanpat Raj and Co.1710, Nai Sarak, Delhi-110 006, 2000.
5. Chenna Kesavulu. N., Text book of engineering geology, II edition, MacMillan Publishers India Ltd. Delhi, 2009.
6. Krynine and Judd Principles of Engineering Geology and Geotechnology McGraw Hill, New York 1962.
7. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub.1 Ed.UK.1994

MGT060	MECHANICS OF UNSATURATED SOILS				L	T	P	C
	Total Contact Hours:45				0	0	2	1
	Prerequisite: Soil Mechanics							
	Course Designed by :Department of Civil Engineering							
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 unsaturated soils.								
COURSE OUTCOMES (COs)								
CO1		To study the state of unsaturated soil						
CO2		To study the physical properties of Air and water						
CO3		To study the stress state variables and shear strength						
CO4		To learn the concept of permeability and hydraulic conductivity						
CO5		To learn about the measurement of total suction						
Mapping of Course Outcomes with 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	M	H					
	CO2	M				M		
	CO3	M	M	H				
	CO4	H						
	CO5	M						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I STATE OF UNSATURATED SOIL

6

Definition – Interdisciplinary nature of unsaturated soil – soil classification – Nature and practice – stress profiles, stress state variables - material variables – constitutive law – suction potential of soil water

UNIT II PHYSICS OF SOIL WATER SYSTEM

9

Physical properties of Air and water – partial pressure and relative Humidity Density of moist air – surface Tension – cavitations 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 AND SHEAR STRENGTH

12

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 pressure distribution.

UNIT IV STEADY AND TRANSIENT FLOWS

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 pumping Analysis.

UNIT V MATERIAL VARIABLE MEASUREMENT AND MODELLING

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 conductivity models.

TOTAL: 45 PERIODS

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 publication No.148.
5. Jean- Louis Briaud., Geotechnical Engineering: Unsaturated and Saturated soils, John Wiley & Sons, INC, New Jersey, 2013.

MGT061	PAVEMENT ENGINEERING					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Transportation Engineering								
	Course Designed by :Department of Civil Engineering								
OBJECTIVES Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions of roads..									
COURSE OUTCOMES (COs)									
CO1	To study the historical development of pavements, types & classification.								
CO2	To learn the factors affecting flexible pavements								
CO3	To design flexible and rigid pavements using IRC methods								
CO4	To suggests modern material, pavement evaluation and rehabilitation								
CO5	To evaluate and carry out stabilization of soils for road constructions								
Mapping of Course Outcomes with 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						
	CO2	H	M			M			
	CO3	H	H	H					
	CO4	H	M						
	CO5	M	M			M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC CONCEPTS

9

Historical development of pavements – types, classification, components and principle of load transfer – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

UNIT II FLEXIBLE PAVEMENT

9

Factors affecting flexible pavements – material characterization for analytical pavement design – AASHO, CBR, group index methods – Importance of Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.

UNIT III RIGID PAVEMENT

9

Factors affecting rigid pavements - Design procedures for rigid pavement – Slab thickness, dowel bar, tie bar, spacing of joints – IRC guidelines – Airfield pavements – Comparison of highway and airfield pavements.

UNIT IV PAVEMENT EVALUATION AND REHABILITATION

9

Pavement evaluation – surface and structural - causes and types of failures in flexible and rigid pavements – Presents serviceability index of roads – Overlay design - pavements maintenance, management and construction – Drainage and its importance in pavements.

UNIT V STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS

9

Need for a stabilized soil – Design criteria – Mechanisms - factors influencing choice of stabilizers - Testing and field control – Applications of Geosynthetics in road construction - Case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. O' Flaherty, C.A., Highways – The location, Design, Construction & Maintenance of Pavements, Fourth Edition, Elsevier, 2006
2. Khanna S.K and Justo C.E.G, Highway Engineering, Eighth Edition, New Chand and Brothers, Roorkee, 2001.

3. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
4. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
5. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
6. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
7. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
- 8.. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996.
9. Bell. P.S., Developments in Highway Engineering, Applied Sciences publishers, 1978.

MGT062	SOIL STRUCTURE INTERACTION					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Soil Mechanics & Foundations Engineering								
	Course Designed by :Department of Civil Engineering								
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)									
CO1	To study soil response models of interaction analysis								
CO2	To solve the infinite and finite beams on elastic foundations								
CO3	To estimate the plate on elastic medium using ACI method								
CO4	To analysis the pile and pile groups using design charts								
CO5	To find the deflection on lateral loaded pile								
Mapping of Course Outcomes with 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			
	CO2	M	H	H					
	CO3	M	M	H					
	CO4	M	H	H					
	CO5	H	M	H		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			

				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

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 FOUNDATIONS 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 – solutions - 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 – Settlement 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.

TOTAL: 45 PERIODS

REFERENCE:

1. Michael J Tomlinson, John C Woodward., Pile Design and Construction Practice, Sixth Edition, CRC Press, 2014
2. Edward Tsodik, “Analysis of Structures on Elastic Foundations”, J. Ross Publishing, Cengage learning India Private limited, Delhi, 2013.
3. Salgado, R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
4. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 200643. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998.

5. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980.
6. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier 1979.
7. Kurien, N.P., "Design of Foundation Systems: Principles and Practices Narosa Publishing House, New Delhi, 1999.

MGT063	ROCK MECHANICS AND APPLICATIONS			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite: Engineering Earth Science						
	Course Designed by :Department of Civil Engineering						
OBJECTIVES Students are expected to classify, understand stress-strain characteristics, 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)							
CO1	To study the classification of rocks.						
CO2	To learn about the strength criteria of rocks and its behavior						
CO3	To analysis the design aspects in rock						
CO4	To understand the slope stability and bearing capacity of rocks						
CO5	To study the reinforcement of fractured and joined rocks						
Mapping of Course Outcomes with 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	M	H				
	CO2	M	H			M	
	CO3	H	H	H			
	CO4	H	H				
	CO5	H	H	H		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
				√			
4	Approval	Board of Studies meeting – 23 rd September 2016					

UNIT I CLASSIFICATION OF ROCKS

9

Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock -

UNIT II STRENGTH CRITERIA OF ROCKS 9

III INSITU STRESSES IN ROCKS 10

UNIT IV SLOPE STABILITY AND BEARING CAPACITY OF ROCKS 9

UNIT V ROCK REINFORCEMENT 8

TOTAL: 45 PERIODS

1. Ramamurthy T. , “Engineering in Rocks for Slopes Foundations and Tunnels”, PHI Learning Pvt. Ltd., 2007.
2. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.
3. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.
4. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.
4. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
6. Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981.
7. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley, 1967.
8. Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.
9. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer-Verlag, Berlin, 1990.

MGT064	EARTH AND ROCK FILL DAMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Engineering Earth Science				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes.					

COURSE OUTCOMES (COs)						
CO1	To learn the types of earth and rock fill dams					
CO2	To study the slope stability and seepage analysis					
CO3	To understand the mechanisms in hydraulic fracturing					
CO4	To study the failure and damages					
CO5	To analysis the special design 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
2	CO1	H	H			
	CO2	H	H			M
	CO3	H	H	H	M	M
	CO4	H	M			
	CO5	H	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I DESIGN CONSIDERATION

9

Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.

UNIT II SLOPE STABILITY AND SEEPAGE ANALYSIS

8

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 and filters.

UNIT III HYDRAULIC FRACTURING

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 core crack.

UNIT IV FAILURE AND DAMAGES**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, Dispersive piping.

UNIT V SLOPE PROTECTION MEASURES**10**

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 performance measurement.

TOTAL: 45 PERIODS**REFERENCES:**

1. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kulwer Academic Publishers, 2001.
2. Jun-Jie Wang, Hydraulic Fracturing in Earth-rock Fill Dams, John Wiley & Sons, 2014.
3. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.
4. Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., Earth and Earth rock dam, John Wiley, 1963.
5. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
6. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.
7. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow, 1986.
8. Chandhar, R.J., Engineering Developments and Applications, Thomas Telford, 1991
9. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.

9.MGT065	FOUNDATION ON EXPANSIVE SOILS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Foundation Engineering				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES To get exposure about various aspects of structures especially constructed on expansive soil. To understand various methods of stabilization used in expansive soils					
COURSE OUTCOMES (COs)					
CO1	To study the general principles in foundation.				
CO2	To do the Laboratory tests for Swelling characteristics				

2. GopalRanjan&A.S.RRao, “Basic and Applied Soil Mechanics”, New Age International Publishers – New Delhi. 2002
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee
4. IS : 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.
5. R.K.Katti, “Search for Solutions in Expansive Soils”.
6. Alam Singh, “Modern Geotechnical Engineering”, Geo-Environ Academia, Jodhapur.
7. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBH, New Delhi.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

REGULATIONS 2015 (REVISED 2015)

DEGREE OF MASTER OF TECHNOLOGY

(IV SEMESTER PROGRAMME)

SEMESTER-I

Theory						
SL.NO.	SUB.CODE	SUBJECT NAME	L	T	P	C
1	MMA 101	Advanced Mathematics for Computing	3	1	0	4
2	MCS 101	Data Structures and Algorithms	3	1	0	4
3	MCS 102	Advanced computer architecture	3	1	0	4
4	MCS 103	Object oriented software engineering	3	1	0	4
5	MCS 104	Network security	3	1	0	4
Practical						
6	MCS 1L1	Software Development Lab	0	0	6	2

Total Credits: 22

SEMESTER-II

Theory						
SL.NO.	SUB.CODE	SUBJECT NAME	L	T	P	C
1	MCS 201	Data Warehousing and Data Mining	3	1	0	4
2	MCS 202	Software Reliability and Software Testing	3	1	0	4
3	MCS 203	Cloud Computing	3	1	0	4
4	MCS 204	Elective –I	3	1	0	4
5	MCS 205	Elective - II	3	1	0	4
Practical						
6	MCS 2L1	Date warehousing and Data Mining Lab	0	0	6	2

Total Credits: 22

SEMESTER-III

Theory						
SL.NO	SUB.CODE	SUBJECT NAME	L	T	P	C
1	MCS 301	Mobile and Pervasive Computing	3	1	0	4
2	MCS 302	Big data Analytics	3	1	0	4
3	MCS 3E1	Elective – III	3	1	0	4
4	MCS 3E2	Elective- IV	3	1	0	4
Project						
5	MCS 3P1	Project Phase – I	0	0	12	6

Total Credits: 22**SEMESTER-IV**

SL.NO	SUB.CODE	SUBJECT NAME	L	T	P	C
Project						
1	MCS 4P2	Project Phase – II	0	0	24	12

Total Credits: 12**TOTAL NO. OF CREDITS FOR THE PROGRAMME: 78**

LIST OF ELECTIVES

SUB.CODE	SUBJECT NAME	L	T	P	C
MCS 111	Object Oriented System Design	3	1	0	4
MCS 112	Software Engineering and Project Management	3	1	0	4
MCS 113	Object Oriented Analysis and Design	3	1	0	4
MCS 114	Software Reliability	3	1	0	4
MCS 115	Software Quality Management	3	1	0	4
MCS 116	Advance Database Technology	3	1	0	4
MCS 117	Parallel And Distributed Databases	3	1	0	4
MCS 118	Advanced Database Administration And Tuning	3	1	0	4
MCS 119	Object Oriented Database Design	3	1	0	4
MCS 120	Cryptography and Computer Security	3	1	0	4
MCS 121	Ad Hoc and Wireless Sensor Networks	3	1	0	4
MCS 122	Wireless Sensor Networks and Programming	3	1	0	4
MCS 123	TCP/IP Technology	3	1	0	4
MCS 124	Network Security and Management	3	1	0	4
MCS 125	TCP/IP Principles and Architecture	3	1	0	4
MCS 126	Wireless Networking and Mobile Computing	3	1	0	4
MCS 127	Information Retrieval Techniques	3	1	0	4
MCS 128	Text Data Mining	3	1	0	4
MCS 129	Web Data Mining	3	1	0	4
MCS 130	Social Network Analysis	3	1	0	4
MCS 131	Digital Signal Processing	3	1	0	4
MCS 132	Image Processing	3	1	0	4
MCS 133	Pattern Recognition Techniques	3	1	0	4
MCS 134	Multimedia Systems	3	1	0	4
MCS 135	Security Principles And Practices	3	1	0	4
MCS 136	Advanced Web Design	3	1	0	4
MCS 137	E-Commerce	3	1	0	4
MCS 138	Speech Recognition	3	1	0	4
MCS 139	Multicore Architecture	3	1	0	4
MCS 140	Stochastic Processes & Queuing Theory	3	1	0	4
MCS 141	Real Time Systems Design	3	1	0	4
MCS 142	Graph Theory and Optimization Techniques	3	1	0	4
MCS 143	Fuzzy And Genetic Algorithm	3	1	0	4
MCS 144	Middleware Technologies	3	1	0	4
MCS 145	Human Computer Interaction	3	1	0	4
MCS 146	Component Based System Design	3	1	0	4
MCS 147	Distributed Operating System	3	1	0	4
MCS 148	Embedded System	3	1	0	4
MCS 149	Speech Technology	3	1	0	4
MCS 150	Information Technology And Cyber Laws	3	1	0	4

MCS 151	PHP Programming	3	1	0	4
MCS 152	Quantum Theory & Algorithm Design	3	1	0	4
MCS 153	Information Security	3	1	0	4
MCS 154	Internet Technology	3	1	0	4
MCS155	Bio-Inspired Artificial Intelligence	3	1	0	4

L	T	P	C
3	1	0	4

Course Objectives:

- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queuing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Identify the type of random variable and distribution for a given operational conditions

CO2: Study and design appropriate queuing model for a given problem or system situation

CO3: To understand and simulate appropriate application and distribution problems

CO4: Differentiate and infer the merit of sampling tests.

CO5: Formulate and find optimal solution in the real life optimizing, allocation and assignment problems involving conditions and resource constraints.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S			M					
CO2	S	S		S								
CO3	S	S		S								
CO4	S	S		S						M		
CO5	S	S		S				M				

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	1. Course End Survey

UNIT I

RANDOM VARIABLES

12

Random Variables – Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal Distributions – Function of a Random Variable - Moments, Moment Generating Function.

UNIT II

QUEUEING MODELS

12

Poisson Process – Markovian Queues – Single and Multi-Server Models – Little's Formula – Machine Interference Model – Steady State Analysis – Self Service Queue.

UNIT III

SIMULATION

12

Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing Systems.

UNIT IV

TESTING OF HYPOTHESIS

12

Sampling Distributions – Estimation of Parameters - Statistical Hypothesis – Tests Based on Normal, t, Chi-Square and F Distributions for Mean, Variance and Proportion.

UNIT V

LINEAR PROGRAMMING

12

Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Hamdy A. Taha, "Operations Research: An Introduction", Prentice Hall of India Pvt., Ltd. New Delhi, Eighth Edition, 2007.
2. Johnson, R.A. Miller and Freund's, "Probability and Statistical for Engineers, Prentice Hall of India Pvt., Ltd., New Delhi, Seventh Edition, 2005.

REFERENCES:

1. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, Seventh Edition, 2009.
2. Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, 2003.
3. J. Medhi, "Stochastic models of Queuing Theory", Academic Press, Elsevier, Amsterdam, 2003.
4. Ross. S.M., "Probability Models for Computer Science", Academic Press, 2002.

L	T	P	C
3	1	0	4

Course Objectives:

- Demonstrate familiarity with major algorithms and data structures.
- Analyze performance of algorithms.
- Choose the appropriate data structure and algorithm design method for a specified application.
- Determine which algorithm or data structure to use in different scenarios.
- Be familiar with writing recursive methods.
- Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs
- Demonstrate understanding of various sorting algorithms, including bubble sort, insertion sort, selection sort, heap sort and quick sort.
- Understand and apply fundamental algorithmic problems including Tree traversals, Graph traversals, and shortest paths.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the basic data structures and its operations.

CO2: Explain the concept of time complexity and space complexity.

CO3: Identify an appropriate data structure for a problem.

CO4: Make use of basic data structures to solve problems.

CO5: Summarize various searching and sorting algorithms.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S								
CO2	S	S	S	S				M				M
CO3	S	S	S	S								
CO4	S	S	S	S		M						
CO5	S	S	S	S								

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I**12**

Overview of data structures, Review of Arrays, sparse matrices, Stacks, Queues, linked lists, doubly linked lists, Applications, dynamic storage management, Algorithm analysis, Efficiency of algorithms, Asymptotic Notations, Time complexity of an algorithm.

UNIT II**12**

Trees: Basic terminology, Binary Trees and its representations, Binary Search Trees, Binary Search Tree traversals, Red-Black Trees, AVL Trees and B Trees, applications of trees, Graphs: Terminology, representations, traversals, spanning trees, shortest paths, Basic Graph Algorithms, Depth first search and Breadth first Search and its analysis, single source shortest path problem, Dijkstra's algorithm.

UNIT III**12**

Divide and Conquer Paradigm: Divide and conquer recurrence equations and their solutions, Review of various sorting techniques using divide and conquer approach, Strassen's matrix multiplication.

UNIT IV**12**

Greedy Paradigm: Basic greedy strategy, Algorithms of Kruskal's and Prim's, greedy strategy in algorithms for the knapsack problem and Huffman trees.

Dynamic Programming paradigm, all pairs shortest path problem, longest common subsequence problems, 0 / 1 Knapsack problem, travelling sales person's problem.

UNIT V**12**

Back Tracking: general method, 4 Queen's Problem, Branch and Bound: general method, LC Search, Control Abstraction, Bounding, 0 / 1 Knapsack Problem.

TOTAL PERIODS: 60**TEXT BOOKS:**

1. Dr. K. Rahava Rao, "Introduction to Design Analysis of Algorithm", SmashWords, 2013.
2. Adam Drozdek, "Data structures and Algorithms in c++", 4th edition, 2012.

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, 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.

MCS102 ADVANCED COMPUTER ARCHITECTURE

L	T	P	C
3	1	0	4

Course Objectives:

- To have a thorough understanding of the basic structure and operation of a digital computer. To discuss in detail the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
- To study the different ways of communicating with I/O devices and standard I/O interfaces.
- To study the hierarchical memory system including cache memories and virtual memory.

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Explain the need to switch from Uniprocessor to Multiprocessor

CO2: Explain the basics of pipelining and the influence of hazards on its performance.

CO3: Summarize the performance of cache memories.

CO4: Explain the storage and i/o requirements for processors.

CO5: Explain about shared memory architecture

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	M								
CO2	S	M	S									
CO3	S	M	M							M		
CO4	S				S							
CO5	S											

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

Overview of Parallel computing, Parallelism in Uniprocessor Systems, Parallel computer structures, Pipeline computers, Array computers, Multiprocessor system, Dataflow computers, Architectural Classification schemes, parallel processing applications.

UNIT II **12**

An overlapped parallelism, Principal of Linear Pipelining, Classification of linear pipeline Instruction and Arithmetic pipelines, Principles of designing pipelined processors, internal forwarding and register tagging, Hazard detection and resolution, Job sequencing and collision prevention, Characteristics of Vector processing, multiple vector task dispatching.

UNIT III **12**

SIMD array processor, SIMD computer organization, Masking and Data routing, SIMD Interconnection network: Static, Dynamic networks, Cube interconnection network, Shuffle exchange and Omega Network, SIMD Matrix multiplication.

UNIT IV **12**

Tightly and loosely coupled multiprocessors, Introduction to Data flow computing and flow Graph, Introduction to 8 bit and 16 bit Intel Microprocessor architecture and register set.

UNIT V **12**

Assembly language programming based on Pentiums; Instruction: Data transfer, Logic, Branch operations, Looping Counting, Indexing, Programming Technique, Counters and Time Delays, Stacks and subroutines, Conditional call and Return Instructions.

TOTAL PERIODS: 60

TEXT BOOKS

1. Patterson and Hennessy, "Quantitative approach to Computer architecture", Mc Graw Hill, 2012.
2. R.S Goankar, "Microprocessor Architecture, programming and application with the 8085", Prentice Hall, 2002.

REFERENCES:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5th Edition, MGH, 2002.

2. D. A. Patterson and J. L. Hennessey, “Computer organization and design,” Morgan Kaufmann, 2002.

MCS103 OBJECT ORIENTED SOFTWARE ENGINEERING

L	T	P	C
3	1	0	4

Course Objectives:

- To investigate principles of object-oriented software engineering, from analysis through testing
- To learn techniques at each stage of development, including use cases, UML, Java and the JDK, and Junit
- To practice these principles and techniques by developing a “real world” software system prototype
- To study and experiment with alternative models of the software development process from the classical waterfall model to Extreme programming
- To discuss and explore recent innovations in OOSE, such as templates&STL, J2EE&JavaBeans, C#&.NET, Design patterns, Aspect-oriented programming, etc.

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Demonstrate the conceptual, practical and technical skills of planning and monitoring a project plan using an appropriate CASE tool

CO2: Demonstrate an understanding of Agile Development

CO3: Describe in detail the theory, concepts and methods pertaining to the Unified Modelling Language (UML).

CO4: Create requirements using use case modelling concepts.

CO5: Demonstrate conceptual and technical skills in the analysis, design and implementation of a software system using Object Oriented Concepts.

CO6: Employ tools and techniques for Object Oriented Software Engineering.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S	S				S			S	
CO2		S	S					S			S	M
CO3	S		S	S				S			S	
CO4			S		S			S			S	
CO5		S	S					S			S	
CO6			S		S			S			S	

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

Review of the traditional methodologies, Object oriented methodology, Advantage of Object oriented methodology

UNIT II **12**

Fundamental concepts of Object Orientation: Object, Class, Abstraction, Interface, Implementation, Aggregation, Composition, Generalization, Sub-Class and Polymorphism, Architecture Style, Object –oriented software engineering, application & component systems, use case components, object components, layered architecture.

UNIT III **12**

Sub- Systems, Services, Coupling, Cohesion and Layering, Static and dynamic aspects of collaborations Reuse processes, Object oriented business engineering, applying business engineering to define processes & organization, application family engineering, component system engineering, application system engineering.

UNIT IV **12**

Organizing a reuse business: Its transaction, Management, working Component based software development: component definition, component meta model, component Engineering vs application engineering

UNIT V **12**

Visual Modeling, Object Oriented Modeling, Component based and Model driven Development using UML:, UML Basics, Component specification, context realization, component realization cases, Actors, and 4+1View.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Jacobson, Griss Jacobson, Patrick Johnsson, “Software Reuse: Architecture, Process and Organization for business Success”, ACM press books, 2009.

REFERENCES:

1. Hans-Gerhard Gross, “Component based Software testing with UML”, Springer, 2005.
2. Craig Larman, “Applying UML and Patterns”, Pearson Education, Second Edition, 2005.

3. GradyBooch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language User Guide”, Pearson Education, Third Edition, 2005.
4. Joffrey S. Poutin, “Measuring Software Reuse: Principles Practices, Economic Models”, Addison Wesley, 2001.

L	T	P	C
3	1	0	4

Course Objectives:

- Describe today's increasing network security threats and explain the need to implement a comprehensive security policy to mitigate the threats .
- Explain general methods to mitigate common security threats to network devices, hosts, and applications .
- Describe the functions of common security appliances and applications .
- Describe security recommended practices including initial steps to secure network devices.

Course Outcomes:**Students will be able to understand**

CO1: Should be able to identify network security threats and determine efforts to counter them

CO2: Should be able to write code for relevant cryptographic algorithms.

CO3: Should be able to write a secure access client for access to a server

CO4: Should be able to send and receive secure mails

CO5: Should be able to determine firewall requirements, and configure a firewall.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S								
CO2	S	S	S	S	S					M		
CO3	M	S	S	S	M							
CO4	S	S	S	S			M					
CO5	M	S	S	S	S							

Course Assessment Methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I	INTRODUCTION	12
OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality.		
UNIT II	PUBLIC KEY CRYPTOGRAPHY	12
Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.		
UNIT III	AUTHENTICATION AND HASH FUNCTION	12
Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard		
UNIT IV	NETWORK SECURITY	12
Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.		
UNIT V	SYSTEM LEVEL SECURITY	12
Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.		

TOTAL PERIODS: 60

TEXTBOOK:

1. William Stallings, “Cryptography And Network Security Principles and Practices”, Prentice Hall of India, Third Edition, 2003.

REFERENCES:

1. AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
2. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Pearson Education, 2003.
3. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.

MCS1L1 SOFTWARE DEVELOPMENT LAB

L	T	P	C
0	0	6	2

Course Objectives:

This laboratory course gives a complete understanding of the practical application in Software Engineering principles and methods.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Analyze the problem and do project planning.

CO2: Identify project scope, objectives, and perform data modeling.

CO3: Identify the deliverables in various phases of SDLC.

CO4: Implement solutions using modern tools.

CO5: Explain test plan, perform validation testing, coverage analysis.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S			M				S	S		
CO2	S	S	M		S							
CO3	S		S		S							
CO4	M	S			M						M	
CO5		M										

Course Assessment methods:

Direct	Indirect
1.Lab Exercise 2.Model Exam 3.Viva Voce 4. End semester practical exam	Course End Survey

Prepare the following documents for each experiment and develop the software using software engineering methodology.

1. Problem Analysis and Project Planning

Thorough study of the problem – Identify project scope, Objectives, infrastructure

2. Software Requirement Analysis

Describe the individual Phases/ modules of the project, Identify deliverables

3. Data Modeling

Use work products – data dictionary, use case diagrams and activity diagrams, build and test lass diagrams, sequence diagrams and add interface to class diagrams.

4. Software Developments and Debugging

5. Software Testing

Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor.

1. Student Course Registration
2. Payroll Processing Application
3. Banking Process
4. Library Management System
5. Railway Reservation System
6. Trading System

TOTAL PERIODS: 45

SEMESTER – II

MCS201 DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	1	0	4

Course Objectives:

- Learn about the Structure of Data Warehouse and its architecture
- Learn about the dramatic advances in data capture, processing power, data transmission, and storage capabilities which enable the organizations to integrate their various databases into data warehouses.
- Understand the concepts of various data mining Techniques

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Explain about the necessity of preprocessing and its procedure.

CO2: Apply the association rules for mining applications.

CO3: Identify an appropriate Classification techniques for various problems with high dimensional data.

CO4: Identify an appropriate Clustering techniques for various problems with high dimensional data

CO5: Outline various mining techniques on complex data objects.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S		S							
CO2	S	M	S		S							
CO3	S	M	S		M							
C04	M		S		M							
CO5	S	M	S		S							

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I: DATA WAREHOUSE**12**

Data warehouse roles and structures – What can a data warehouse do? – The cost of warehousing data. Data stores, Warehouses and Marts - The Data warehouse environment – Data warehouse characteristics - The Data Warehouse architecture - Metadata, Metadata Extraction - Implementing the Data Warehouse. Designing and building the Data Warehouse – The data warehouse project plan - Data warehouse architecture, specification and development - Data warehouse project success factors.

UNIT II: INTRODUCTION TO DATA MINING**12**

Basic Data Mining tasks, Data mining versus Knowledge discovery in data bases, Data Mining issues, Data Mining Metrics, Social implications of data mining, Data Mining from a database perspective. Data mining techniques - Introduction – A statistical perspective on Data mining – Similarity measures – Decision trees – Neural networks – Genetic algorithms.

UNIT III: CLASSIFICATION**12**

Introduction - Statistical based algorithms- Distance based algorithms – Decision tree based algorithms - Neural networks based algorithms – Rule based algorithms – Combining Techniques.

UNIT- IV: CLUSTERING**12** Introduction – Similarity and distance measures-

Outliers – Hierarchical algorithms – Partitional algorithms – Clustering large data bases - Clustering with categorical attributes - Association Rules – Introduction – Large Item-sets – Basic Algorithms.

UNIT- V: WEB MINING, SPATIAL MINING, TEMPORAL MINING**12**

Web Mining – Introduction – Web Content Mining – Web Structure Mining – Web Usage Mining. Spatial Mining – Introduction – Spatial Data: Overview – Spatial Data Mining primitives - Generalization and Specialization – Spatial Rules – Spatial Classification algorithm – Spatial Clustering Algorithms. Temporal Mining – Introduction: Modeling temporal events.

TOTAL PERIODS: 60**TEXT BOOK:**

1. Margaret H. Dunham, “Data Mining Introductory and Advanced Topics”, Pearson Education, 2003.

REFERENCE BOOKS:

1. George M. Marakas, “Modern Data Warehousing, Mining and Visualization: Core concepts”, Pearson Education, 2003.
2. Aruj K Pujari, “Data Mining Techniques”, Universities Press, 2001.

L	T	P	C
3	1	0	4

Course Objectives:

- The ability to tackle challenging computing problems using a comprehensive knowledge of computer science, while reflecting a commitment to quality, innovation, critical thinking, and continuous improvement.
- The ability of analyzing and solving complex technical problems from a broad perspective of computer science, including business, societal, and regulatory issues.
- The ability to function as both a leader and collaborative team member within different environments.
- The ability to Communicate effectively to all constituencies and uphold a commitment to professional and ethical conduct.

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Outline software testing methods

CO2: Summarize risk in software project development.

CO3: Develop knowledge in understanding the importance of Software Reliability.

CO4: Utilize the appropriate testing techniques for information systems development.

CO5: Apply the metrics involved in software development.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S								S	
CO2	S		S							M	S	
CO3	S		S	S							S	
CO4	S		S							M	S	
CO5	S		S							M	S	

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I	12
INTRODUCTION TO RELIABILITY ENGINEERING	
Reliability - Repairable and Non Repairable systems - Maintainability and Availability - Designing for higher reliability - Redundancy - MTBF - MTTF MDT - MTTR- k out of n systems	
UNIT II	12
SOFTWARE RELIABILITY	
Software reliability - Software reliability Vs Hardware reliability - Failures and Faults - Classification of Failures - Counting - System Configuration - Components and Operational Models - Concurrent Systems - Sequential Systems - Standby Redundant systems	
UNIT III	12
SOFTWARE RELIABILITY APPROACHES	
Fault Avoidance - Passive Fault detection - Active Fault Detection - Fault Tolerance - Fault Recovery - Fault Treatment.	
UNIT IV	12
INTRODUCTION	
Software testing – Role of software testing – A structural approach to testing – Test strategy – methods for developing test strategy testing methodologies. Test plan – Requirements testing – Walk through test tool – Risk matrix test tool – Testing for requirements phase and design phase – Design review test tool – Test data and volume test tools.	
UNIT V	12
TESTING METHODS	
Installation phase testing – Tools for acceptance test – Software acceptance process – Software maintenance – Methodologies for testing – Training and change installation. Tools and techniques – Cost estimate – For testing – Testing phase of life cycle – Point accumulation tracking system – Performance analysis of testing – Inspection plan and test plan documents.	

TOTAL NO OF PERIODS: 60

TEXT BOOKS:

1. John D. Musa, "Software Reliability", McGraw Hill, 2004.
2. Patric D. T.O Connor, "Practical Reliability Engineering", 4th Edition, John Wesley & sons, 2003
3. William Perry, "Effective Methods for Software Testing", 3/e, John Wiley & Sons/ Wiley India, 2006.

REFERENCE BOOKS:

1. DoronPeled, "Software Reliability Methods", Springer, 2011.
2. Alessandro Birolini, "Reliability Engineering", Springer, 2010
3. Ron Patton, "Software Testing", Techmedia, 2005
4. A.P.Mathur, "Foundations of Software Testing", Pearson Education. 2008
5. Rajni, Renu; Oak, Pradeep, "Software Testing: Effective Methods, Tools and

L	T	P	C
3	1	0	4

Course Objectives:

This module gives students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization.

Course Outcomes:

After successful completion of this course, students should be able to

- CO1: Explain the cloud computing paradigm and its various forms of services
 CO2: Identify the architecture, infrastructure and delivery models of cloud computing
 CO3: Apply suitable virtualization concepts.
 CO4: Illustrate different Programming Models and approaches.
 CO5: Apply cloud Toolkits to solve the problems

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S		M							
CO2	S	M	S		S							
CO3	S		M		S							
CO4	S		S	M	S							
CO5	S		S		S							

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I UNDERSTANDING CLOUD COMPUTING 12

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

UNIT II DEVELOPING CLOUD SERVICES 12

Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-

Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds

UNIT III CLOUD COMPUTING FOR EVERYONE 12

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation

UNIT IV USING CLOUD SERVICES 12

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files

UNIT V OTHER WAYS TO COLLABORATE ONLINE 12

Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Kumar Saurabh, “Cloud Computing Insights into New Era Infrastructure”, Wiley Indian Edition, 2011.
2. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2008.

REFERENCE BOOKS:

1. Haley Beard, “Cloud Computing Best Practices for Managing and Measuring Processes for On demand Computing, Applications and Data Centres in the Cloud with SLAs”, Emereo Pty Limited, 2008.

L	T	P	C
3	1	0	4

Course Objectives:

The objective of the lab exercises is to use data mining techniques and to use standard databases available to understand DM processes (using any DM tool).

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Demonstrate the importance of preprocessing the given datasets.

CO2: Design and implement classification algorithm to classify given problems using modern tools.

CO3: Design and implement clustering algorithm to group the given attributes in a dataset using modern tools.

CO4: Demonstrate to find association rules for the given datasets using modern tools.

CO5: Develop skills to design data warehouse for an enterprise.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S	S		S							
CO2		S	S		S							
CO3		S	S		S							
CO4		S	S		S							
CO5		S	S		S							

Course Assessment methods:

Direct	Indirect
1.Lab Exercise 2.Model Exam 3.Viva Voce 4. End semester practical exam	Course End Survey

List of Experiments:

1. Listing applications for mining
2. File format for data mining
3. conversion of various data files
4. Training the given dataset for an application
5. Testing the given dataset for an application
6. Generating accurate models
7. Data pre-processing – data filters
8. Feature selection
9. web mining
10. Text mining
11. Design of fact & dimension tables
12. Generating graphs for star schema.

TOTAL PERIODS: 60

**MCS301 MOBILE AND PERVASIVE
COMPUTING**

L	T	P	C
3	1	0	4

Course 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:

After successful completion of this course, the students should be able to

- To deploy 3G networks.
- : To develop suitable algorithms for 4G networks.
- : To use sensor and mesh networks to develop mobile computing environment.
- : To develop mobile computing applications based on the paradigm of context aware Computing.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									
CO2	S		S									
CO3	S		S				M					
CO4	S		S				M					

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

**UNIT I
INTRODUCTION**

12

Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing – Categories of Pervasive Devices

UNIT II

3G AND 4G CELLULAR NETWORKS

12

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

12

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

12

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

12

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 PERIODS: 60

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”, Morgan Kaufmann 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 Hansmann et al, “Principles of Mobile Computing”, Springer, 2003.

L	T	P	C
3	1	0	4

Course Objectives:

- To understand big data analytics as the next wave for businesses looking for competitive advantage
- To understand the financial value of big data analytics
- To explore tools and practices for working with big data
- To understand how big data analytics can leverage into a key component
- To understand how to mine the data
- To learn about stream computing
- To know about the research that requires the integration of large amounts of data

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Identify the need for big data analytics for a domain

CO2: Use Hadoop, Map Reduce Framework

CO3: Apply big data analytics for a give problem

CO4: Suggest areas to apply big data to increase business outcome

CO5: Contextually integrate and correlate large amounts of information automatically to gain faster insights.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S									S
CO2			S		M							S
CO3			S		M							S
CO4			S								M	S
CO5			S									S

- **Course Assessment methods:**

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

INTRODUCTION TO BIG DATA

12

Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options
Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of
Big Data -Security, Compliance, auditing and protection - Evolution of Big data – Best
Practices for Big data Analytics - Big data characteristics - Volume, Veracity, Velocity,
Variety – Data Appliance and Integration tools – Greenplum – Informatica

UNIT II

DATA ANALYSIS

12

Evolution of analytic scalability – Convergence – parallel processing systems – Cloud
computing –grid computing – map reduce – enterprise analytic sand box – analytic data sets –
Analytic methods –analytic tools – Cognos – Microstrategy - Pentaho. Analysis approaches –
Statistical significance –business approaches – Analytic innovation – Traditional approaches
– Iterative

UNIT III

STREAM COMPUTING

12

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing,
Sampling data in a stream – Filtering streams – Counting distinct elements in a stream –
Estimating moments – Counting oneness in a window – Decaying window - Realtime
Analytics Platform(RTAP)applications IBM Infosphere – Big data at rest – Infosphere
streams – Data stage – Statistical analysis– Intelligent scheduler – Infosphere Streams

UNIT IV

PREDICTIVE ANALYTICS AND VISUALIZATION

12

Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen
models –Normal – Deviations from normal patterns – Normal behaviours – Expert options –
Variable entry -Mining Frequent itemsets - Market based model – Apriori Algorithm –
Handling large data sets in Mainmemory – Limited Pass algorithm – Counting frequent
itemsets in a stream – Clustering Techniques –Hierarchical – K- Means – Clustering high
dimensional data Visualizations - Visual data analysis techniques, interaction techniques;
Systems and applications:

UNIT V

FRAMEWORKS AND APPLICATIONS

12

IBM for Big Data – Map Reduce Framework - Hadoop – Hive - – Sharding – NoSQL
Databases - S3 -Hadoop Distributed file systems – Hbase – Impala – Analyzing big data with
twitter – Big data for Ecommerce– Big data for blogs.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS BusinessSeries, 2012.
2. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”,Elsevier, 2007
3. Michael Berthold, David J. Hand,” Intelligent Data Analysis”, Springer, 2007.

REFERENCES:

1. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge UniversityPress, 2012.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams withAdvanced Analytics”, Wiley and SAS Business Series, 2012.
3. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for EnterpriseClass Hadoop and Streaming Data”, McGraw Hill, 2011.
4. Pete Warden, Big Data Glossary, O’Reilly, 2011.
5. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier,Reprinted 2008.
6. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

MCS 111 OBJECT ORIENTED SYSTEM DESIGN

L	T	P	C
3	1	0	4

Course Objectives:

- The objective of this course is to expose the students to the Fundamentals and benefits of software reuse and some reuse problems.
- To provide a clear understanding of the advance concepts in developing different types of reusable component and processes for reuse

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To prepare object oriented design for small and medium scale problem.

CO2: To evaluate the appropriate life cycle model for the system under consideration.

CO3: To apply the various tools and patterns while developing software

CO4: Testing the software against usability, deployment, maintenance.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S	S		S	M					S	S
CO2		S	S		S	M					M	S
CO3		M	M		S	S					S	M
CO4		M	S		M	S					M	S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I**12**

Review of the traditional methodologies, Object oriented methodology, Advantage of Object oriented methodology.

UNIT- II**12**

Fundamental concepts of Object Orientation: Object, Class, Abstraction, Interface, Implementation, Aggregation, Composition, Generalization, Sub-Class and Polymorphism, Architecture Style, Object –oriented software engineering, application & component systems, use case components, object components, layered architecture.

UNIT- III**12**

Sub- Systems, Services, Coupling, Cohesion and Layering, Static and dynamic aspects of collaborations Reuse processes, Object oriented business engineering, applying business engineering to define processes & organization, application family engineering, component system engineering, application system engineering

UNIT - IV**12**

Organizing a reuse business: Its transaction, Management, working Component based software development: component definition, component meta model, component engineering vs application engineering.

UNIT -V**12**

Visual Modelling, Object Oriented Modelling, Component based and Model driven development using UML:, UML Basics, Component specification, context realization Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance

TOTAL HOURS: 60**REFERENCE:**

1. Alistair Cockburn, “Agile Software Development” 2nd edition, Pearson Education, 2007.
2. Bernd Bruegge, Alan H Dutoit, “Object-Oriented Software Engineering”, 2nd edition, Pearson Education, 2003.

L	T	P	C
3	1	0	4

MCA112 SOFTWARE ENGINEERING AND PROJECT MANAGEMENT

Course Objectives:

- To provide students with a clear understanding of the unique risks, issues, and critical success factors associated with technology projects.
- To introduce students to the role and function of project management.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: It Enables the students understand what is a product, project and process is.

CO2: It enables students understand the lifecycle for a software project.

CO3: It enables students understand how the quality of a software product is calculated.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	M		S	M	S			M	
CO2	S		S			S	M	S			M	
CO3	S		S			S		S				

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I **12**

Exposure to Software Project Management: Software development as a project, Stakeholders in software project, Software product, process, resources, quality, and cost, Objectives, issues, and problems relating to software projects.

UNIT -II **12**

Overview of Project Planning: Steps in project planning; Defining scope and objectives; work breakdown structure; Deliverables and other products

UNIT -III **12**

Software Effort Estimation: Problem in software estimation; Effort estimation techniques COCOMO model.

Risk Analysis and Management: Nature and categories of risk in software development; risk Identification; Risk assessment; Risk mitigation, monitoring, and management;

UNIT -IV **12**

Selection of Appropriate Project Approach: Rapid application development; Waterfall model; V-process model; Spiral model; Prototyping, Incremental delivery.

UNIT -V **12**

Software Quality Assurance : Planning for quality; Product versus process quality management; Procedural and quantitative approaches; Defect analysis and prevention; Statistical process control; Pareto analysis; Causal analysis; Quality standards; ISO 9000; Capability Maturity Model; Quality audit.

TOTAL HOURS: 60

TEXT BOOKS:

1. Bob Hughes and Mike Cotterell, "Software Project Management", Tata McGraw-Hill Edition, 2010
2. Joel Henry, "Software Project Management", Pearson Education, 2009.
3. Pankaj Jalote, "Software Project Management in practice", Pearson Education, 2005

REFERENCE:

1. S. A. Kelkar, "Software Project Management", PHI, 2012.

MCS 113 OBJECT ORIENTED ANALYSIS AND DESIGN

L	T	P	C
3	1	0	4

Course Objectives:

- To enable the students to design UML diagrams and to develop applications.
- To help the students to visualize the structure of the system and to reduce the system development time thereby increasing the productivity according to the industrial standards

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain fundamental concepts of object-oriented analysis and design approach.

CO2: Explain models for object-oriented system development.

CO3: Identify system development design patterns

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S	M			S			S	M
CO2		M	S	S	M			S			S	
CO3	S	M	S	M	M			S			S	

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I	12
INTRODUCTION	
Object Basics - Classes and Objects - Inheritance - Object relationship - Dynamic binding - OOSD Life Cycle - Analysis - Design - Implementation - Testing.	
UNIT -II	12
METHODOLOGY AND UML	
Overview of methodologies - OMT, Booch methodology, Jacobson methodology; Patterns - Frameworks - Unified Approach - UML - Static and Dynamic Modeling, UML diagrams.	
UNIT -III	12
ANALYSIS	
Use case model; Approaches for identifying classes - Noun Phrase approach - Responsibilities - collaborators - Identifying Object relationships - case study.	
UNIT -IV	12
DESIGN	
Design Process - Design Axioms, Class Design, Object Storage and Object Interoperability; Access Layer - OODBMS, View Layer; case study.	
UNIT -V	12
SOFTWARE QUALITY	
Testing Strategies - Test cases - Test plan - Continuous testing - debugging principles - case study.	

TOTAL HOURS: 60

TEXT BOOKS:

- 1 .Booch G., "Object Oriented Analysis and Design", Addison Wesley Publishing Company, 3rd Edition, 2009.
- 2.Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition,2008.
- 3.Mike O'docherty, ., "Object Oriented Analysis and Design", Addison Wesley Publishing Company, 2nd Edition, 2005.

REFERENCES:

1. Michael Blaha,"Object Oriented Modeling and Design", Pearson, 2012.
2. B.S.Ainapure, ,"Object Oriented Modeling and Design",Pearson,2005.

MCS114 SOFTWARE RELIABILITY

L	T	P	C
3	1	0	4

Course Objectives:

To provide knowledge in

- Design principles for creating safe and reliable systems
- Reliability modeling
- Current trends in software reliability

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Understand common principles of software and system reliability engineering and also system safety.

CO2: Learn about software reliability measures.

CO3: Study software test methodology.

CO4: Learn about modeling software reliability growth.

CO5: Analyze the reliability of multi-component systems.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S			S						M
CO2	S		S		S	S					S	S
CO3	S	S	S	M		S						
CO4	S		S		S	S						S
CO5	S	M	S		S	S				M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I	12
INTRODUCTION TO RELIABILITY ENGINEERING	
Reliability - Repairable and Non Repairable systems - Maintainability and Availability - Designing for higher reliability - Redundancy - MTBF - MTTF MDT - MTTR- k out of n systems	
UNIT -II	12
SOFTWARE RELIABILITY	
Software reliability - Software reliability Vs Hardware reliability - Failures and Faults - Classification of Failures - Counting - System Configuration - Components and Operational Models - Concurrent Systems - Sequential Systems - Standby Redundant systems	
UNIT -III	12
SOFTWARE RELIABILITY APPROACHES	
Fault Avoidance - Passive Fault detection - Active Fault Detection - Fault Tolerance - Fault Recovery - Fault Treatment	
UNIT- IV	12
SOFTWARE RELIABILITY MODELING	
Introduction to Software Reliability Modeling - Parameter Determination and Estimation - Model Selection - Markovian Models - Finite and Infinite failure category Models - Comparison of Models - Calendar Time Modeling	
UNIT -V	12
SPECIAL TOPICS IN SOFTWARE RELIABILITY	
Management Techniques for reliability - Organization and Staffing - Programming Languages and Reliability - Computer Architecture and Reliability - Proving Program correctness & Reliability Design - Reliability Testing - Reliability Economics	
TOTAL HOURS: 60	

TEXT BOOKS

1. John D. Musa, "Software Reliability", McGraw Hill, 2004.
2. Patric D. T.O Connor, "Practical Reliability Engineering", 4th Edition, John Wesley & sons, 2003.

REFERENCES

1. Doron Peled, "Software Reliability Methods", Springer, 2011.
2. Alessandro Birolini, "Reliability Engineering", Springer, 2010.

MCS115 SOFTWARE QUALITY MANAGEMENT

L	T	P	C
3	1	0	4

Course Objectives:

- To understand how to choose appropriate quality goals and to select, to plan, and to execute quality assurance activities throughout development and evolution to predictably meet quality and schedule goals.
- To study the software quality engineering metrics and models

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Employ software metrics and models in software development

CO2: select the best quality assurance plan during development

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S			S						M
CO2	S		S		S	S					S	S
CO3	S	S	S	M		S						
CO4	S		S		S	S						S
CO5	S	M	S		S	S				M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I	12
INTRODUCTION	
Concepts of Quality Control, Quality Assurance, Quality Management - Total Quality Management; Cost of Quality; QC tools - 7 QC Tools and Modern Tools; Other related topics - Business Process Re-engineering - Zero Defect, Six Sigma, Quality Function Deployment, Benchmarking, Statistical process control.	
UNIT -II	12
SOFTWARE ENGINEERING PRINCIPLES	
Software Engineering Principles, Software Project Management, Software Process, Project and Product Metrics, Risk Management.	
UNIT -III	12
SOFTWARE QUALITY ASSURANCE MODELS	
Software Quality Assurance; Statistical Quality Assurance - Software Reliability, Models for Quality Assurance - ISO-9000 - Series, CMM, SPICE, Malcolm Baldrige Award.	
UNIT -IV	12
SOFTWARE PROCESSES & TESTING	
Software Process - Definition and implementation; internal Auditing and Assessments; Software testing - Concepts, Tools, Reviews, Inspections & Walkthroughs; P-CMM.	
UNIT -V	12
TQM	
Total Quality Management - Introduction, Software reuse for TQM, Software testing method for TQM, Defect Prevention and Total Quality Management, Zero Defect Software Development, Clean room Engineering.	

TOTAL HOURS: 60

TEXT BOOKS:

1. Allan Gillies, "Software quality Theory & Management ", Thomson international Press ,2011.
2. Amitava Mitra, "Fundamentals of Quality Control and Improvement" ,Wiley, 2008.

REFERENCES:

1. Roger Pressman, "Software Engineering ", 6th edition, McGraw Hill, 2005.
2. Kim H. Pries, Jon M. Quigley, "Total Quality Management for Software", CRC Press, 2005.

MCS 116 ADVANCE DATABASE TECHNOLOGY

L	T	P	C
3	1	0	4

Course Objectives:

- The objective of this course is to expose the students to the implementation techniques of database system.
- This course explains techniques for query processing and optimization with transaction and concurrency control techniques

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: It enables the students to understand the concept of relational databases and relational operations.

CO2: It enables the students to understand the concept of Object Oriented Databases and its Operations.

CO3: It enables the students to understand the concept of Parallel and Distributed Databases.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									S
CO2	S		S		M							S
CO3	S		S									S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I

RELATIONAL DATABASES

12

Integrity Constraints revisited, Extended ER diagram, Relational Algebra & Calculus, Functional, Multi valued and Join Dependency, Normal Forms, Rules about functional dependencies.

UNIT -II

QUERY PROCESSING AND OPTIMIZATION

12

Valuation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.

UNIT -III

OBJECTED ORIENTED AND OBJECT RELATIONAL DATABASES

12

Modelling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases.

UNIT - IV

PARALLEL AND DISTRIBUTED DATABASES

12

Distributed Data Storage – Fragmentation & Replication, Location and Fragment Transparency Distributed Query Processing and Optimization, Distributed Transaction Modelling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.

UNIT -V

ADVANCED TRANSACTION PROCESSING

12

Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors. Multimedia databases, Databases on the Web and Semi-Structured Data Case Study: Oracle 10g and 11i.

TOTAL HOURS: 60

TEXT BOOKS:

1. Dietrich, and Urban, "An Advanced Course in Database Systems", Pearson, 2008.
2. Elmars, Navathe, Somayajuu, Gupta, "Fundamentals of Database Systems", 4th Edition, Pearson Education, 2007
3. Garcia, Ullman, Widom, "Database Systems, The complete book", Pearson Education, 2007.

REFERENCES:

1. Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8th Edition Pearson Education, 2007.
2. Singh S.K., "Database System Concepts, design and application", Pearson Education, 2006.

3. Silberschatz, Korth, Sudarshan, "Database System Concepts",
Mcgraw Hill, 6th Edition, 2006.

L	T	P	C
3	1	0	4

MCS117 PARALLEL AND DISTRIBUTED DATABASES

Course Objectives:

- To realize the need of parallel processing, to cater the applications that require a system capable of sustaining trillions of operations per second on very large data sets
- To understand the need of data integration over data centralization

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Students Get good knowledge on the need, issues, design and application of both parallel and distributed databases.

CO2: Students know how to write optimal queries to cater applications of that need these forms of databases.

CO3: Students be able to fragment, replicate and localize their data as well as their queries to get their work done faster.

CO4: Students Get idea on other similar trends of optimal data processing.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									S
CO2	S		M		M							M
CO3	S		S									M
CO4	S		S									S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

INTRODUCTION TO PARALLEL DATABASES

Need of Parallelism - Forms of parallelism – architecture – Analytical models. Basic Query Parallelism – Parallel Search- Parallel sort and Group By- Parallel Join

UNIT II **12**

ADVANCED QUERY PROCESSING IN PARALLEL DATABASES

Parallel indexing. Parallel Universal Qualification – Collection Join Queries. Parallel Query Scheduling – Optimization, Applications

UNIT III **12**

INTRODUCTION TO DISTRIBUTED DATABASES

Overview - Promises of DDB –Design Issues – DDB Design – DDB Integration – Data and Access Control.

UNIT IV **12**

QUERY PROCESSING IN DISTRIBUTED DATABASES

Overview- of Query Processing – Query Decomposition and Data Localization – Optimization of Queries, Multi-database Query Processing.

UNIT V **12**

TRANSACTION MANAGEMENT AND OTHER ADVANCED SYSTEMS

Introduction – Concurrency Control - Distributed DBMS Reliability – Data Replication – DDB Applications, Distributed Object Database Management – Peer -to-Peer Data Management – Web Data Management – Streaming Data and Cloud Computing.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Sandro Fiore, Giovanni Aloisio ,“Grid and Cloud Database management”,ACM,2011.
2. David Taniar, Clement H.C.Leung, Wenny Rahayu, Sushant Goel , “High performance parallel Database processing and Grid databases” , John Wiley & Sons, 2008.

REFERENCES:

1. M. Tamer Ozsu and Patrick Valduriez, “Principles of Distributed Database Systems”, Springer Science + Business Media , 3rd Edition, 2011.

L	T	P	C
3	1	0	4

MCS118 ADVANCED DATABASE ADMINISTRATION AND TUNING

Course Objectives:

- At the end of the course the students would be able to
- Design and implement relational database solutions for general applications.
- Develop database scripts for data manipulation and database administration.
- Understand and perform common database administration tasks, such as database Monitoring, performance tuning, data transfer, and security.

Course Outcomes:

- CO1: Students understands advanced features of databases in design, administration, and applications
- CO2: Aspires to improve the performance of a database
- CO3: Students learn about optimization of existing resources usage within the database environment.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									S
CO2	S		S									S
CO3	S		S									S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I

12

INTRODUCTION TO DATABASE ADMINISTRATION

Database Administration - DBA Tasks- Database Design -Performance Monitoring and Tuning – Availability - Database Security and Authorization - Backup and Recovery - Data Integrity- DBMS Release Migration - Types of DBAs - Creating the Database Environment - Choosing a DBMS - DBMS Architectures - DBMS Clustering -DBMS Proliferation - Hardware Issues -Installing the DBMS - DBMS Installation Basics Hardware Requirements - Storage Requirements Memory Requirements Configuring the DBMS - Connecting the DBMS to Supporting Infrastructure Software –Installation Verification - DBMS

Environments - Upgrading DBMS Versions and Releases - Fallback Planning Migration Verification

UNIT II

12

DATABASE SECURITY, BACKUP AND RECOVERY

Database Users - Granting and Revoking Authority - Types of Privileges - Granting to PUBLIC Revoking Privileges - Security Reporting - Authorization Roles and Groups - Using Views for Security - Using Stored Procedures for Security Auditing External Security - Job Scheduling and Security - Image Copy Backups - Full vs. Incremental Backups - Database Objects and Backups – DBMS. Control - Concurrent Access Issues Backup Consistency - Log Archiving and Backup – DBMS Instance Backup - Designing the DBMS Environment for Recovery - Alternate Approaches to Database Backup - Recovery - Determining Recovery Options Types of Recovery – DBA Tools – DBA Rules of Thumb.

UNIT III

12

FUNDAMENTALS OF TUNING

Review of Relational Databases – Relational Algebra – Locking and Concurrency Control – Correctness Consideration – Lock Tuning – Logging and the Recovery Subsystem – Principles of Recovery – Tuning the Recovery Subsystem – Operating Systems Considerations – Hardware Tuning.

UNIT IV

INDEX TUNING AND QUERY OPTIMIZATION

12

Types of Queries – Data Structures – B tree – B+ Tree - Hash Structures – Bit Map Indexes – Clustering Indexes – Non Clustering Indexes – Composite Indexes – Hot Tables – Comparison of Indexing and Hashing Techniques. Optimization Techniques - Tuning Relational Systems – Normalization – Tuning Denormalization – Clustering Two Tables – Aggregate maintenance – Record Layout – Query Cache – Parameter Cache - Query Tuning – Triggers – Client Server Mechanisms – Objects, Application Tools and Performance – Tuning the Application Interface – Bulk Loading Data – Accessing Multiple Databases.

UNIT V

12

TROUBLESHOOTING

Query Plan Explainers – Performance Monitors – Event Monitors – Finding “Suspicious” Queries – Analyzing a Query’s Access Plan – Profiling a Query Execution – DBMS Subsystems.

TOTAL PERIODS: 60

TEXT BOOK :

1. Dennis Shasha and Philippe Bonnet, “Database Tuning, Principles, Experiments and Troubleshooting Techniques”, Elsevier Reprint 2005.
2. Craig S. Mullins, “Database Administration: The Complete Guide to Practices and Procedures”, Addison-Wesley Professional, 2002.

REFERENCES:

1. Silberschatz, Korth, Database System Concepts, McGraw hill, 6th edition, 2010.

1. Thomas Connolly and Carlolyn Begg, Database Systems, A Practical Approach to Design, implementation and Management, Fourth Edition, Pearson Education 2008.

L	T	P	C
3	1	0	4

MCS119 OBJECT ORIENTED DATABASE DESIGN

Course Objectives:

- To introduce basic and fundamental concepts of DBMS & ER model.
- To introduce the concepts of extended ER model and object oriented programming database concepts

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Design and motivate software architecture for large scale software systems.

CO2: Recognize major software architectural styles, design patterns, and frameworks

CO3: Describe a software architecture using various documentation approaches

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S		S							S
CO2	S	S	S		M							S
CO3	S	M	S		S							S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT-I

12

Database management systems - The concepts of the database- levels of representation, using a DBMS, Relational systems - toward the relational model, The relational model, using a relational system, Advantages & limitations of relational systems, A new generation of systems - A new computing context, New Applications.

UNIT-II

12

Fundamental Aspects - The role of the data model general principles, Data manipulation languages, some important models - ER, SDM, IFO, RM/T, Daplex, Type systems - Concept of type. Data abstraction. Polymorphism, sub typing Integrating models & type system-

Abstract types and modeling, concepts of inheritance, classes & relations, views & desired data constants & transaction.

UNIT-III **12**

Extended relational models and system - different approaches, model with structured values, Deductive models and logic programming, models with object identity. Extensible systems, Database programming language - Two approaches Integration into an existing language, Persistent programming languages.

UNIT-IV **12**

Object oriented systems - Principles & technology databases, The O2 system - origins & objective Data model, Data manipulation, interface generator, the programming environment, Implementation of the O2 system.

UNIT-V **12**

Object manager architecture - Introduction, Problems encountered, Addressing mechanisms, Virtual memory, Two address levels, distributed architecture, Data management - Data representation, Large sets & long strings, Representing inheritance, Indexing, clustering, transactions & versions.

TOTAL HOURS: 60

TEXT BOOKS:

1. C.S.R. Prabhu, "Object-Oriented Database Systems: Approaches and Architectures", 2nd edition., Prentice-Hall Of India Pvt. Limited, 2005.
2. Jan L. Harrington, "Object-oriented Database Design Clearly Explained", Morgan Kaughman, 2000.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharson, "Database System Concepts", 6th Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education, 2008.
3. M. Tamer Ozsu and Patric Valduricea, "Principles of Distributed Database systems", Pearson Education, 2000.

L	T	P	C
3	1	0	4

MCS120 CRYPTOGRAPHY AND COMPUTER SECURITY

Course Objectives:

- To learn the concepts of trust categories
- To understand trust architecture and formalization of security properties
- To learn trusted computing and administration

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain security issues and objectives in computer systems and networks.

CO2: Explain the workings of fundamental cryptographic, authentication, network security and system security algorithms.

CO3: Identify the appropriate cryptography scheme & security mechanism for different Computing environment and information systems.

CO4: Develop security protocols and methods to solve societal security problems.

CO5: Analyze security of network protocols and systems.

Pre-requisites:Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S								S
CO2	S	S	S	S	M							S
CO3	S	S	S	S	M							S
CO4	S	M	S	S								S
CO5	S	S	S	S								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

INTRODUCTION

12

Introduction – Trust and Computing – Instantiations – Design and Applications –Progression – Motivating scenarios – Attacks. Design goals of the trusted platform modules. Introduction to simulators – Implementation of attacks.

UNIT II

12

ARCHITECTURE, VALIDATION AND APPLICATION CASE STUDIES

Foundations – Design challenges – Platform Architecture – Security architecture – erasing secrets – sources – software threats – code integrity and code loading. Outbound Authentication – Problem – Theory – Design and Implementation - Validation – Process – strategy – Formalizing security properties – Formal verification – other validation tasks – reflection. Application case studies – Basic building blocks – Hardened web servers – Right's management for Big Brother's computer – Private Information – Other projects TCPA/TCG.

UNIT III –

PROGRAMMING INTERFACES TO TCG

12

Experimenting with TCPA/TCG – Desired properties- Lifetime mismatch – Architecture – Implementation – Applications. Writing a TPM device driver- Low level software – Trusted boot – TCG software stack – Using TPM keys. Implementation using simulator tools.

UNIT IV

TSS CORE SERVICE AND SECURE STORAGE

12

TSS core service – Public key cryptography standard – Architecture – Trusted computing and secure storage – Linking to encryption algorithms – encrypting files and locking data to specific PCs-content protection – secure printing and faxing. Simulation analysis of symmetric and public key cryptographic standards - performance evaluation of these trust models.

UNIT V

TRUSTED COMPUTING AND SECURE IDENTIFICATION

12

Trusted Computing and secure identification – Administration of trusted devices – Secure /backup maintenance – assignment of key certificates-secure time reporting-key recovery – TPM tools- Ancillary hardware.

TOTAL HOURS: 60

TEXT BOOKS:

1. Challener D., Yoder K., Catherman R., Safford D., Van Doorn L.. “A Practical Guide to Trusted Computing”. IBM press, 2008.

2. Sean W.Smith, “Trusted Computing Platforms: Design and Applications”.Springer Science and Business media, 2005.

REFERENCES

1. William Stallings, “Cryptography and Network Security – Principles and Practices”, Prentice Hall of India, Third Edition, 2003.
2. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, pearson Education, 2003.
4. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.

L	T	P	C
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MCS121 AD HOC AND WIRELESS SENSOR NETWORKS

Course Objectives:

- To learn about the issues in the design of wireless ad hoc networks
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks
- To expose the students to different aspects in sensor networks
- To understand various security issues in ad hoc and sensor networks and solutions to the issues.

Course Outcomes:

After successful completion of this course, the students should be able to

- CO1: Apply knowledge of wireless sensor networks to various application areas.
CO2: Design, implement and maintain wireless sensor networks.
CO3: Formulate and solve problems creatively.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S								S
CO2	S	S	S	S	M							S
CO3	S	S	S	S								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I

12

MAC & ROUTING IN AD HOC NETWORKS

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple- Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

UNIT- II

12

TRANSPORT & QOS IN AD HOC NETWORKS

TCP's challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

UNIT -III **12**

MAC & ROUTING IN WIRELESS SENSOR NETWORKS

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zig bee – Topology Control – Routing Protocols

UNIT -IV **12**

TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless SensorN Networks – Congestion Control – In-network processing – Operating systems for wireless sensor networks – Examples.

UNIT -V **12**

SECURITY IN AD HOC AND SENSOR NETWORKS

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Antitamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

TOTAL HOURS: 60

TEXT BOOKS:

1. Erdal Çayirci , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
2. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
3. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Inc., 2005.
4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004.

REFERENCES:

1. Carlos De Moraes Cordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition)”, World Scientific Publishing, 2011.
2. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.
3. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.

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MCS122 WIRELESS SENSOR NETWORKS AND PROGRAMMING

Course Objectives:

- Gain knowledge of mobile ad hoc networks, design and implementation issues, and available solutions.
- Gain knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid.
- Knowledge of the 802.11 Wireless Lan (WiFi) and Bluetooth standards.
- Knowledge of sensor networks and their characteristics. This includes design of MAC layer protocols, understanding of power management, query processing, and sensor databases.
- Hands-on experience in designing and implementing ad hoc network functionality using network simulation tools and Pocket PCs.

Course Outcomes:

CO1: Apply knowledge of wireless sensor networks to various application areas.

CO2: Design, implement and maintain wireless sensor networks.

CO3: Formulate and solve problems creatively.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S				S				S
CO2	S	M	S	S	M			S				S
CO3	S	S	S	S				S				S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT – I

12

INTRODUCTION TO WSN

Introduction and Overview of Wireless Sensor Networks Introduction, Brief Historical Survey of Sensor Networks, and Background of Sensor Network Technology, Ad-Hoc Networks, Applications of Wireless Sensor Networks: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor

Applications, Another Taxonomy of WSN Technology, Basic Sensor Network Architectural Elements, Home Control, Medical Applications, Basic Wireless Sensor Technology : Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Network Standards: IEEE 802.15.4, ZigBee, IEEE 1451

UNIT – II

MEDIUM ACCESS CONTROL

12

Medium Access Control Protocols for Wireless Sensor Networks Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs: Schedule-Based Protocols, Random Access-Based Protocols, Coordination, Schedule Synchronization, Adaptive Listening, Access Control and Data Exchange (B-MAC, Box-MAC, Bit-MAC, H-MAC, I-MAC, O-MAC, S-MAC, Ri-MAC, T-MAC, QMAC (Query MAC), Q-MAC (QoS MAC), X-MAC).

UNIT – III

12

ROUTING IN WSN

Routing Protocols for Wireless Sensor Networks Introduction, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks Network Scale and Time-Varying Characteristics, Resource Constraints, Sensor Applications Data Models, Routing Strategies in Wireless Sensor Networks: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information Systems, Directed Diffusion, Geographical Routing,

UNIT -IV

12

TCP AND UDP

Transport Control Protocols and Middle wares for Wireless Sensor Networks Traditional Transport Control Protocols: TCP (RFC 793), UDP (RFC 768), MobileIP, Introduction, WSN Middleware Principles, Middleware Architecture: Existing Middleware: MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services),

UNIT- V

12

OPERATING SYSTEMS IN WSN

Operating Systems for Wireless Sensor Networks Introduction, Examples of Operating Systems: TinyOS, Mate, MagnetOS

TEXT BOOKS:

1. KazemSohraby, Daniel Minoli, TaiebZnati ,”Wireless Sensor Network,” Wiley,2007.
2. Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong ,”Wireless Sensor Networks Signal Processing and Communications”John Wiley & Sons,2007.

REFERENCES:

1. Sridhar S. Iyengar, NandanParameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, “ Fundamentals of Sensor Network Programming: Applications and Technology” Wiley,2011.
2. C. S. Raghavendra ,”Wireless sensor networks” Springer,2007.
3. Murthy ,”Ad Hoc Wireless Networks: Architectures And Protocols “, Pearson Education,2004.

MCS123 TCP/IP TECHNOLOGY

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Course Objectives:

To learn the basics of socket programming using TCP Sockets.

- To learn about Socket Options
- To learn to develop Macros for including Objects In MIB Structure
- To understand SNMPv1, v2 and v3 protocols & practical issues.

Course Outcomes:

At the end of this course the student will be able to

CO1: Understand the internals of the TCP/IP protocols

CO2: Understand how TCP/IP is actually implemented

CO3: Understand the interaction among the protocols in a protocol stack

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S								S
CO2	S	S	S	S	M							S
CO3	S	M	S	S								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

FUNDAMENTALS

12

Internetworking concepts - IP and datagram forwarding - TCP services - Interactive data flow - Timeout and retransmission - Bulk data flow - Persist timer – Keep-alive timer.

UNIT II

12

ARP AND IP Structure of TCP/IP in OS - Data structures for ARP - Cache design and management - IP software design and organization - Sending a datagram to IP

UNIT III

12

IP ROUTING IMPLEMENTATION Routing table - Routing algorithms - Fragmentation and reassembly - Error processing (ICMP) - Multicast Processing (IGMP).

UNIT IV

12

TCP I/O PROCESSING AND FSM

Data structure and input processing - Transmission control blocks - Segment format - Comparison - Finite state machine implementation - Output processing - Mutual exclusion - Computing TCP data length

UNIT V

TCP TIMER AND FLOW CONTROL

12

Timers - Events and messages - Timer process - Deleting and inserting timer event - Flow control and adaptive retransmission - Congestion avoidance and control - Urgent data processing and push function

TOTAL HOURS : 60

TEXT BOOKS

1. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, 4th edition, McGraw Hill, 2013.
2. Douglas E. Comer, “Internetworking with TCP/IP: principles, protocols and architecture” (Volume1), 6th Edition, PHI Learning, 2013.

REFERENCES:

1. Douglas E. Comer, David L. Stevens, “Internetworking with TCP/IP, design, implementation and internals Volume 2, 3rd Edition, PHI Learning, 2009.
2. Ed Tittel, Laura Chappell, “TCP/IP”, 1st Edition, Cengage Learning, 2008.
3. Dr. Sidnie Feit, TCP/IP, architecture, protocols and implementation with IPv6 and IP Security, Tata McGraw-Hill, 2008.

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Course Objectives:

- The objective of this course is to identify the different network security measures and to analyze each of them.
- To study protocols, issues related to implementation of network security

Course Outcomes:

The student will be able to

CO1: put into practice the various symmetric and asymmetric key algorithms.

CO2: understand the importance of network security.

CO3: handle different kinds of attacks

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S				S			S	S
CO2	S		S	S			M	S			S	S
CO3	S	M	S	S			M	S			M	S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -1**12****CRYPTOGRAPHY**

Classical Cryptography, Various types of Cipher, Cryptanalysis, Computer Security, Threats to security, History of Computer security, Computer System Security and Access Controls (System access and data access). Threats- Viruses, worms, Trojan horse, bombs, trap doors, spoofs, email virus, macro Viruses, remedies, Intruders, Malicious software, Firewalls, vulnerabilities & Threats, Network Denial of service attack.

UNIT- II**12****SWITCHING AND ROUTING**

Technologies - Switching Design, Switching Types - Layer 2 and 3 Switching, Spanning Tree Protocol, Redundancy in Layer 2 Switched Networks, STP Terminology and Operation,

Virtual LANs – Trunks - Inter-VLAN Routing - Multilayer Switching, Switching Security and Switching Design Considerations IPv4 Routing Design. IPv4 Address Design - Private and Public Addresses – NAT - Subnet Masks - Hierarchical IP Address Design - IPv4 Routing Protocols – Classification - Metrics - Routing Protocol Comparison - IPv4 Routing Protocol Selection.

UNIT III **12**
VULNERABILITIES

Network Security Design, Hacking – Vulnerabilities - Design Issues - Human Issues - Implementation Issues – Threats - Reconnaissance Attacks - Access Attacks - Information Disclosure Attacks - Denial of Service Attacks- Threat Defense - Secure Communication - Network Security Best Practices - SAFE Campus Design.

UNIT IV **12**
NETWORK SECURITY

Network Security-Kerberos, X.509, some network security projects - SDNS, DISNet, Project MAX, Secure NFS Security- E-Mail Security, IP security, Web security, Server security- security for network server, web servers, mobile technologies (java and Java script etc)

UNIT V **12**
CASE STUDY

Network Management Design: ISO Network Management Standard - Protocols and Tools – SNMP – MIB – RMON - Cisco NetFlow – Syslog – Cisco Works - Network Management Strategy - SLCs and SLAs – IP Service-Level Agreements – Content Networking Design – Case Study – Venti Systems.

TOTAL HOURS: 60

TEXT BOOKS:

1. Introduction to computer Security- Mathew Bishop, Addison-Wisley, 2006.
2. 2. Diane
Tiare and Catherine Paquet, —Campus Network Design Fundamentals, Pearson education, 2006.
3. William Stallings, “Cryptography and Network Security – Principles and Practices”, PHI, 3rd Edition.
4. Atul Kahate, “Cryptography and Network Security”, TMH, 2003

REFERENCES:

1. William Stallings; Network Security Essentials, Pearson publication, 2005.
2. William Stallings” Cryptography and Network Security, Pearson publication, 4th edition, 2004.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Pearson Education, 2003.
4. Mathew Bishop ,”Computer Security: Art and Science” , Addison-Wisley, 2003.

5. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.

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5. Craig Zacker, “The Complete Reference: Upgrading and Troubleshooting Networks”, Tata McGraw-Hill, 2000.

MCS125 TCP/IP PRINCIPLES AND ARCHITECTURE

Course Objectives:

- To provide a solid foundation for understanding the communication process of the Internet
- Provide exposure to fundamental concepts of computer networking in the context of the TCP/IP model and protocols.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the principles of internetworking protocols.

CO2: Summarize the functions of transport protocols.

CO3: Explain the concepts of routing, subnetting and super netting.

CO4: Get an exposure to various next generation protocols in internetworking.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	S	S								S
CO2		M	S	S		M						S
CO3			S	S								
CO4			S	S		M						

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I

12

INTRODUCTION

Protocols and standards - OSI model - TCP/ IP protocol suite - addressing - versions - underlying technologies.

UNIT -II

12

IP ADDRESSES, ROUTING, ARP AND RARP

Classful addressing - other issues - subnetting - supernetting - classless addressing - routing methods - delivery - table and modules - CIDR - ARP package - RARP.

UNIT -III **12**

IP, ICMP, TGMP AND UDP

Datagram - fragmentation - options - checksum - IP package - ICMP - messages, formats - error reporting - query - checksum - ICMP package - IGMP - messages, operation - encapsulation - IGMP package - UDP - datagram - checksum - operation - uses - UDP package.

UNIT- IV **12**

TCP, UNICAST AND MULTICAST ROUTING PROTOCOLS

Services - flow, congestion and error control - TCP package and operation - state transition diagram - unicast routing protocols - RIP - OSPF - BGP - multicast routing - trees - protocols - MOSPF - CBT - PIM.

UNIT -V **12**

APPLICATION LAYER, SOCKETS

Client server model - concurrency - processes - sockets - byte ordering - socket system calls - TCP and UDP client-server programs - BOOTP -DHCP - DNS - name space, resolution - types of records - concept - mode of operation - Rlogin.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Behrouz A. Forouzan, "TCP/IP Protocol Suite", 4th edition, McGraw Hill, 2013.
2. Douglas E. Comer, "Internetworking with TCP/IP: principles, protocols and architecture" (Volume1), 6th Edition, PHI Learning, 2013.

REFERENCES:

1. Douglas E. Comer, David L. Stevens, "Internetworking with TCP/IP, design, implementation and internals Volume 2, 3rd Edition, PHI Learning, 2009.
2. Ed Tittel, Laura Chappell, "TCP/IP", 1st Edition, Cengage Learning, 2008.
3. Dr. Sidnie Feit, TCP/IP, architecture, protocols and implementation with IPv6 and IP Security, Tata McGraw-Hill, 2008.

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MCS126 WIRELESS NETWORKING AND MOBILE COMPUTING

Course

Objectives:

- Data communications and resource management,
- Network protocols and distributed computing,
- Information management, user interfaces, applications/services, and security.

Course Outcomes:

On successful completion of this module, the student should:

- CO1: Have knowledge and understanding of basic mobile network architecture
CO2: Have knowledge and understanding of some basic technologies that are in use
CO3: Be able to make critical assessment of mobile systems
CO4: Be able to analyze and propose broad solutions for a range of mobile scenarios

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S	S								S
CO2	S	M	S	S						M		S
CO3	S		S	S					M			S
CO4	S	M	S	S								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

12

Wireless transmission – Frequencies for radio transmission ,signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum , Cellular system
Telecommunication systems – GSM, Digital enhanced cordless telecommunications(DECT)

UNIT II **12**
Wireless Medium Access control and CDMA- based communication – Medium access control, Introduction to CDMA-based systems, Spread spectrum in CDMA systems, coding methods in CDMA

UNIT III **12**
Wireless LAN – Infra red vs radio transmission, infrastructure and ad hoc networks, IEEE 802.11, Bluetooth

UNIT IV **12**
Mobile network layer – Mobile IP, Dynamic host configuration protocol, Mobile ad-hoc networks, Wireless sensor networks 6. Mobile transport layer – Traditional TCP, Classical TCP improvements, snooping TCP, Mobile TCP, TCP over 2.5/3G wireless networks

UNIT V **12**
Mobile internet connectivity – WAP 1.1, Layers of WAP, Wireless Application Environment, WML and WML Script , wireless telephony application, WAP 2.0 architecture , XHTMLMP(Extensible Hypertext Markup Language Mobile profile) Mobile Operating System ,Mobile file system, Security in mobile computing, Wireless network simulator such as ns2

TOTAL HOURS: 60

TEXT BOOKS:

1. Raj Kamal," Mobile Computing" ,Oxford, 2012.
2. Jochen Schiller ,"Mobile Communication", Pearson Education, ,2009

REFERENCES:

1. Asoke K. Talukdar,"Mobile Computing", 2nd edition, Tata McGrawHill,2010.
2. Stojmenovic," Handbook of Wireless Networks and Mobile Computing",Wiley ,2006.

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MCS 127 INFORMATION RETRIEVAL TECHNIQUES

Course Objectives:

- To understand the basics of Information Retrieval with pertinence to modelling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering
- To understand the various applications of Information Retrieval giving emphasis to Multimedia IR, Web Search
- To understand the concepts of digital libraries

Course Outcomes:

Upon completion of the course, the students will be able to

- CO1: Build an Information Retrieval system using the available tools
CO2: Identify and design the various components of an Information Retrieval system
CO3: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO4: Analyze the Web content structure
CO5: Design an efficient search engine

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M							S		S
CO2			S	S						M		S
CO3	S		S	M						S		M
CO4			S							M		S
CO5	S		M	M						S		S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

INTRODUCTION: MOTIVATION

12

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval –Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine

UNIT II

MODELING

12

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III

INDEXING

12

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV

TEXT CLASSIFICATION AND NAIVE BAYES

12

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning

UNIT V SEARCHING THE WEB

12

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

TOTAL PERIODS: 60

TEXT BOOKS:

1. Ricardo Baeza – Yates, BerthierRibeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search “,ACM Press Books, Second Edition 2011.
2. Ricardo Baeza – Yates, BerthierRibeiro – Neto, “Modern Information Retrieval”, Pearson Education, Second Edition, 2005.

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition 2012.
2. Stefan Butcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval Implementing and Evaluating Search Engines”, The MIT Press, 2010.

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MCS128 TEXT DATA MINING

Course Objectives:

- To understand the basic issues and types of text mining
- To appreciate the different aspects of text categorization and clustering
- To understand the role played by text mining in Information retrieval and extraction
- To appreciate the use of probabilistic models for text mining
- To appreciate the current trends in text mining

Course Outcomes:

Upon Completion of the course, the students will be able to

CO1: Identify the different features that can be mined from text and web documents.

CO2: Use available open source classification and clustering tools on some standard text data sets

CO3: Modify existing classification/clustering algorithms in terms of functionality or features used

CO4: Design a system that uses text mining to improve the functions of an existing open source search engine

CO5: Implement a text mining system that can be used for an application of your choice

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S						M			S
CO2	S		S		M						M	S
CO3	S	M	S	M			M					S
CO4	M		M									S
CO5	S		S	M								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

INTRODUCTION

Overview of text mining- Definition- General Architecture– Algorithms– Core Operations – Pre processing–Types of Problems- basics of document classification- information retrieval- clustering and organizing documents- information extraction- prediction and evaluation- Textual information to numerical vectors -Collecting documents- document standardization- tokenization- lemmatization vector generation for prediction- sentence boundary determination -evaluation performance.

UNIT II

TEXT CATEGORIZATION AND CLUSTERING **12**

Text Categorization – Definition – Document Representation –Feature Selection - Decision Tree Classifiers - Rule-based Classifiers - Probabilistic and Naive Bayes Classifiers - Linear Classifiers- Classification of Linked and Web Data - Meta-Algorithms– Clustering – Definition- Vector Space Models - Distance-based Algorithms- Word and Phrase-based Clustering -Semi-Supervised Clustering - Transfer Learning

UNIT III

TEXT MINING FOR INFORMATION RETRIEVAL AND INFORMATION EXTRACTION **12**

Information retrieval and text mining- keyword search- nearest-neighbor methods- similarity- webbased document search- matching- inverted lists- evaluation. Information extraction- Architecture - Co-reference - Named Entity and Relation Extraction- Template filling and database construction – Applications. Inductive -Unsupervised Algorithms for Information Extraction. Text Summarization Techniques - Topic Representation - Influence of Context - Indicator Representations – Pattern Extraction - Apriori Algorithm – FP Tree algorithm

UNIT IV

PROBABILISTIC MODELS **12**

Probabilistic Models for Text Mining -Mixture Models - Stochastic Processes in Bayesian Nonparametric Models - Graphical Models - Relationship Between Clustering, Dimension Reduction and Topic Modelling - Latent Semantic Indexing - Probabilistic Latent Semantic Indexing –Latent Dirichlet Allocation- Interpretation and Evaluation - Probabilistic Document Clustering and Topic Models - Probabilistic Models for Information Extraction - Hidden Markov Models - Stochastic Context- Free Grammars - Maximal Entropy Modelling - Maximal Entropy Markov Models -Conditional Random Fields.

UNIT V RECENT TRENDS**12**

Visualization Approaches - Architectural Considerations - Visualization Techniques in Link Analysis - Example- Mining Text Streams - Text Mining in Multimedia - Text Analytics in Social Media – Opinion Mining and Sentiment Analysis - Document Sentiment Classification Opinion Lexicon Expansion - Aspect-Based Sentiment Analysis - Opinion Spam Detection Text Mining Applications and Case studies

TOTAL HOURS: 60**TEXT BOOKS:**

1. Sholom Weiss, Nitin Indurkha, Tong Zhang, Fred Damerau “The Text Mining Handbook:
2. Advanced Approaches in Analyzing Unstructured Data”, Springer, paperback 2010.

REFERENCES:

1. Charu C. Aggarwal ,ChengXiang Zhai, “Mining Text Data”, Springer; 2012.
1. Ronen Feldman, James Sanger -“ The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”,Cambridge University press, 2006.

L	T	P	C
3	1	0	4

MCS129

WEB DATA MINING

Course Objectives:

- To focus on a detailed overview of the data mining process and techniques, specifically those that are relevant to Web mining
- To Understand the basics of Information retrieval and Web search with special emphasis on web Crawling
- To appreciate the use of machine learning approaches for Web Content Mining
- To understand the role of hyper links in web structure mining
- To appreciate the various aspects of web usage mining

Course Outcomes:

Upon Completion of the course, the students will be able to

- CO1: Build a sample search engine using available open source tools
- CO2: Identify the different components of a web page that can be used for mining
- CO3: Apply machine learning concepts to web content mining
- CO4: Implement Page Ranking algorithm and modify the algorithm for mining information
- CO5: Process data using the Map Reduce paradigm
- CO6: Design a system to harvest information available on the web to build recommender systems
- CO7: Analyze social media data using appropriate data/web mining techniques
- CO8: Modify an existing search engine to make it personalized

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S	M	S							S
CO2	S		S		M			M				S
CO3	M		S									S
CO4	S	M	S						M			S
CO5	S		S		M							S
CO6	S		S								M	S
CO7	S	M	S	M								M
CO8	S		S									S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I 12**INTRODUCTION**

Introduction – Web Mining – Theoretical background – Algorithms and techniques – Association rule mining – Sequential Pattern Mining -Information retrieval and Web search – Information retrieval Models-Relevance Feedback- Text and Web page Pre-processing – Inverted Index – Latent Semantic Indexing – Web Search – Meta-Search – Web Spamming

UNIT II 12**WEB CONTENT MINING**

Web Content Mining – Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers. Unsupervised Learning - K-means Clustering - Hierarchical Clustering –Partially Supervised Learning – Markov Models - Probability-Based Clustering - Evaluating Classification and Clustering – Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction - Opinion Mining and Sentiment Analysis – Document Sentiment Classification

UNIT III 12**WEB LINK MINING**

Web Link Mining – Hyperlink based Ranking – Introduction -Social Networks Analysis- Co Citation and Bibliographic Coupling - Page Rank -Authorities and Hubs -Link-Based Similarity Search - Enhanced Techniques for Page Ranking - Community Discovery – Web Crawling -A Basic Crawler Algorithm- Implementation Issues- Universal Crawlers- Focused Crawlers- Topical Crawlers- Evaluation - Crawler Ethics and Conflicts - New Developments

UNIT IV 12**STRUCTURED DATA EXTRACTION**

Structured Data Extraction: Wrapper Generation – Preliminaries- Wrapper Induction- Instance-Based Wrapper Learning - Automatic Wrapper Generation: Problems - String Matching and Tree Matching -. Multiple Alignment - Building DOM Trees - Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching - Schema-Level Match -Domain and Instance-Level Matching – Extracting and Analyzing Web Social Networks.

UNIT V

WEB USAGE MINING

12

Web Usage Mining - Click stream Analysis -Web Server Log Files - Data Collection and Pre- Processing - Cleaning and Filtering- Data Modelling for Web Usage Mining - The BIRCH Clustering Algorithm -Affinity Analysis and the A Priori Algorithm – Binning. Discovery and Analysis of Web Usage Patterns – Modelling user interests –Probabilistic Latent Semantic Analysis – Latent Dirichlet Allocation Model– Applications- Collaborative Filtering- Recommender Systems – Web Recommender systems based on User and Item – PLSA and LDA Models

TOTAL PERIODS : 60

TEXT BOOKS:

1. Guandong Xu ,Yanchun Zhang, Lin Li, “Web Mining and Social Networking: Techniques and Applications”, Springer; 1st Edition.2010.
1. Bing Liu, “ Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-2entric Systems and Applications)”, Springer; 2nd Edition 2009.
2. Zdravko Markov, Daniel T. Larose, “Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage”, John Wiley & Sons, Inc., 2007.

REFERENCES:

1. Min Song, Yi Fang and Brook Wu, “Handbook of research on Text and Web mining technologies”, IGI global, information Science Reference – imprint of :IGI publishing, 2008.
2. Adam Schenker, “Graph-Theoretic Techniques for Web Content Mining”, World Scientific Pub Co Inc ,2005.
3. Soumen Chakrabarti, “Mining the Web: Discovering Knowledge from Hypertext Data”, Morgan Kaufmann; edition 2002.

L	T	P	C
3	1	0	4

Course Objectives:

- To gain knowledge about the current Web development and emergence of Social Web.
- To study about the modelling, aggregating and knowledge representation of Semantic Web.
- To learn about the extraction and mining tools for Social networks.
- To gain knowledge on Web personalization and Web Visualization of Social networks.

Course Outcomes:

Upon Completion of the course, the students will be able to

CO1: To apply knowledge for current Web development in the era of Social Web.

CO2: To model, aggregate and represent knowledge for Semantic Web.

CO3: To design extraction and mining tools for Social networks.

CO4: To develop personalized web sites and visualization for Social networks.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	S	M		M	S		M		
CO2		M	S	S			S	M				
CO3			S	M			M	S		M		
CO4			S	S			S	M		M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

INTRODUCTION TO SOCIAL NETWORK ANALYSIS

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web - Network analysis - Development of Social Network Analysis- Key concepts and measures in network analysis - Electronic sources for network analysis - Electronic discussion networks, Blogs and online communities, Web-based networks - Applications of Social Network Analysis.

UNIT II **12**

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web - Ontology-based Knowledge Representation – Ontology languages for the Semantic Web – RDF and OWL - Modelling and aggregating social network data - State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced Representations.

UNIT III **12**

EXTRACTION AND MINING COMMUNITITES IN WEB SOCIAL NETWROKS

Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Definition of Community - Evaluating Communities - Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Tools for Detecting Communities Social Network Infrastructures and Communities - Decentralized Online Social Networks- Multi- Relational Characterization of Dynamic Social Network Communities.

UNIT IV **12**

PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES

Understanding and Predicting Human Behaviour for Social Communities - User Data Management, Inference and Distribution - Enabling New Human Experiences - Reality Mining - Context-Awareness - Privacy in Online Social Networks - Trust in Online Environment - Trust Models Based on Subjective Logic - Trust Network Analysis - Trust Transitivity Analysis - Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons - Attack Spectrum and Countermeasures.

UNIT V **12**

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph Theory- Centrality- Clustering - Node-Edge Diagrams, Matrix representation, Visualizing Online Social Networks, Visualizing Social Networks with Matrix-Based Representations- Matrix + Node-Link Diagrams, Hybrid Representations - Applications - Covert Networks - Community Welfare - Collaboration Networks - Co-Citation Networks.

TOTAL HOURS: 60

TEXT BOOKS:

1. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking Techniques and applications”, Springer, 1st edition, 2011.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer,
3. 1st edition, 2010.
4. Peter Mika, “Social networks and the Semantic Web”, Springer, 1st edition 2007.

REFERENCES:

1. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, “Collaborative and social information retrieval and access: techniques for improved user modelling”, IGI Global snippet, 2009.
2. John G. Breslin, Alexandre Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009.
3. Dion Goh and Schubert Foo, “Social information retrieval systems: emerging technologies and applications for searching the Web effectively”, IGI Global snippet, 2008.

MCS131 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	1	0	4

Course Objectives:

- This course will introduce the basic concepts and techniques for processing signals on a computer.
- By the end of the course, you be familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.
- The course emphasizes intuitive understanding and practical implementations of the theoretical concepts.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Outline the characteristics of discrete-time signals and discrete systems

CO2: Analyze signal / system properties using mathematical tools

CO3: Apply and develop algorithms for digital systems

CO4: Illustrate efficient computation of DFT

CO5: Explain the advanced features and architecture of generic P-DSP

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S								
CO2	S	M	S	S			M					
CO3	S	M	M	S				M				
CO4	S	M	S	S								
CO5	M		S	S				S				

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

Sampling of Analogue signals – aliasing – standard discrete time signals – classification – discrete time systems – Linear time invariant stable casual discrete time systems – classification methods – linear and circular convolution – difference equation representation – DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms. Time response and frequency response analysis of discrete time systems to standard input signals.

Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – pre warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

Symmetric and Anti symmetric FIR filters – Linear phase FIR filters – Design using Frequency sampling technique – Window design using Hamming, Hanning and Blackmann Windows – Concept of optimum equiripple approximation – Realisation of FIR filters – Transversal, Linear phase and Poly phase realization structures.

Quantization noise – derivation for quantization noise power – Fixed point and binary floating point number representations – Comparison – Overflow error – truncation error – coefficient quantization error – limit cycle oscillations- signal scaling – analytical model of sample and hold operations.

Discrete Random Signals- Mean, Variance, Co-variance and PSD – Periodiogram
Computation – Principle of Multi rate DSP – decimation and Interpolation by integer factors
– Time and frequency domain descriptions – Single, Multi stage, poly phase structures –
QMF filters – Subband Coding

TEXT BOOKS:

1. Alan V Oppenheim, Alan S. Willsky, Hamid Nawab, “Signals & Systems”, Pearson Education, 2nd Edition ,2000.
2. John Proakis, Dimitris G Manolakis, “Digital Signal Processing Principles, Algorithms and Application”, PHI, 3rd Edition ,2000.

1. S.K. Mitra, "Digital signal processing-A Computer based approach", Tata McGraw-Hill, 3rd Edition, 2004.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons, 2nd Edition, 2002.

3. S. Salivahana, A.Vallavaraj, Gnanapriya, “Digital Signal Processing”, McGraw-Hill, 2nd Edition, 2000.

MCS 132

IMAGE PROCESSING

L	T	P	C
3	1	0	4

Course Objectives:

- To understand the basic concepts of digital image processing and various image transforms.
- To familiarize the student with the image processing facilities in MAT Lab
- To expose the student to a broad range of image processing techniques and their applications, and to provide the student with practical experience using them.
- To appreciate the use of current technologies those are specific to image processing systems.
- To expose the students to real-world applications of image processing.

Course Outcomes:

On successful completion of this course, students should be able to

CO1: Upon Completion of the course, the students Should have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.

CO2: Implement basic image processing algorithms using MATLAB tools.

CO3: Explore advanced topics of Digital Image Processing.

CO4: Ability to Apply and develop new techniques in the areas of image enhancement-restoration segmentation- compression-wavelet processing and image morphology.

CO5: Make a positive professional contribution in the field of Digital Image Processing.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S	S							
CO2	S	S	S	S	M							
CO3	M	M		M								
CO4	S	M		S	M							
CO5	S	S		M	M							

Course Assessment methods

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar	Course End Survey

4. Online Test	
5. End Semester Exam	

UNIT I

FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS 12

Introduction – Steps in Digital Image Processing – Image sampling and Quantization – Basic Relationships between pixels – Color Fundamentals – File Formats – Image Transforms: DFT, DCT, Haar, SVD and KL- Introduction to Mat lab Toolbox.

UNIT II

IMAGE ENHANCEMENT AND IMAGE RESTORATION 12

Image Enhancement in the Spatial Domain: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Spatial Filtering, Fuzzy sets for spatial filters – Image Enhancement in the Frequency Domain: Frequency Domain Filters – Image Restoration: Model of Image Degradation/Restoration Process, Noise Models, Linear and non linear image restoration techniques, Blind Deconvolution.

UNIT III

MULTI RESOLUTION ANALYSIS AND IMAGE COMPRESSION 12

Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Fast Wavelet Transforms, Lifting scheme. Image Compression: Fundamentals – Models – Elements of Information Theory – Error Free Compression – Lossy Compression-wavelet based image compression techniques – Compression standards-JPEG/MPEG, Video compression.

UNIT IV

12

IMAGE SEGMENTATION AND DESCRIPTION

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Basic Morphological Algorithms, Morphological Water Sheds - Description: Boundary Descriptors, Regional Descriptors.

UNIT V

12

CURRENT TRENDS AND APPLICATIONS OF IMAGE PROCESSING

Applications: Image Classification, Object Recognition, Image Fusion, Steganography – Current Trends: Color Image Processing, Wavelets in Image Processing.

TOTAL PERIODS: 60

TEXT BOOKS:

1. I.S. Sridhar, “Digital Image Processing”, Oxford University Press, 2011.
2. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Pearson Education, 3rd Edition, 2008.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, PHI, 2006.

REFERENCES:

1. Rafael C.Gonzalez, Richard E.Woods, and Eddins, “Digital Image Processing Using MATLAB”, Tata McGraw-Hill, 2nd Edition, 2009.
2. Sanjit K. Mitra, & Giovanni L. Sicuranza, “Non Linear Image Processing”, Elsevier, 2007.

MCS 133 PATTERN RECOGNITION TECHNIQUES

L	T	P	C
3	1	0	4

Course Objectives:

- To study the fundamental algorithms for pattern recognition.
- To instigate the various classification techniques.
- To originate the various structural pattern recognition and feature extraction techniques

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Summarize on supervised and unsupervised classification methods for various pattern recognition problems.

CO2: Identify appropriate clustering techniques for various problems with high dimensional data.

CO3: Explain about various structural pattern recognition models.

CO4: Outline feature extraction and subset selection methods for various applications.

CO5: Explain about the neural networks for pattern recognition problems and Fuzzy Pattern Classifiers.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S								
CO2	S	S	S	S								
CO3	M	M		M								
CO4	S	M		S								
CO5	S	S		M								

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT – I

PATTERN CLASSIFIER

12

Overview of Pattern Recognition-Discriminate Functions-Supervised Learning-Parametric Estimation-Maximum Likelihood Estimation-Bayesian Parameter Estimation-Perception Algorithm-LNSE Algorithm-Problems with Bayes Approach-Pattern Classification by Distance Functions-Minimum Distance Pattern Classifier.

UNIT – II

UNSUPERVISED CLASSIFIER

12

Clustering for Unsupervised Learning and Classification-Clustering Concept-C Means Algorithm-Hierarchical Clustering Procedures-Graph Theoretic Approach to Pattern Clustering-Validity of Clustering Solutions.

UNIT – III

STRUCTURAL PATTERN RECOGNITION

12

Elements of Formal Grammars-String Generation as Pattern Description-Recognition of Syntactic Description-Parsing-Stochastic Grammars and Applications-Graph Based Structural Representation.

UNIT – IV

FEATURE EXTRACTION AND SELECTION

12

Entropy Minimization-Kahunen-Loeve Transformation-Feature Selection through functions Approximation-Binary Feature Selection.

UNIT – V

RECENT ADVANCES

12

Neural Network Structures for Pattern Recognition-Neural Network based Pattern Associators-Unsupervised Learning in Neural Pattern Recognition-Self Organizing Networks-Fuzzy Logic-Fuzzy Pattern Classifiers-Pattern Classification using Genetic Algorithms.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Ariel, Francisco, Kittler “Advances in Pattern recognition, Springer, 2010.
2. Robert J. Schalkoff, “Pattern Recognition: Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 2007.

REFERENCES:

1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

2. Duda R.O , Hart P.E., “Pattern Classification”, Wiley, 2001.

L	T	P	C
3	1	0	4

MCS134 MULTIMEDIA SYSTEMS

Course Objectives:

- To present a step-by-step approach to multimedia systems design.
- To introduce multimedia standards and compression and decompression technologies.
- To provide a detailed analysis of the various storage technologies.

Course Outcomes:

After successful completion of this course, students should be able to

- CO1: Understand different realizations of *multimedia* tools and their usage.
 CO2: Implement various multimedia standards and compression technologies.
 CO3: Analyze various storage technologies.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		M					S		S
CO2					S		M			M		S
CO3	M				S					S	M	M

• Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I

12

Introduction: Motivation, evolution of multimedia, structure and components of multimedia, application domain, Internet and multimedia, hypertext, hypermedia, browser and helper application overview, user interface design issues.

UNIT -II

12

Sound and Audio Technology

Psychoacoustics: frequency and amplitude sensitivity of hearing, music and noise, stereo effects, masking; Frequency domain compression of analog signal, digitization of audio signal: sampling and coding, digital audio signal processing, architecture of sound card, electronic music and synthesizer, MIDI: Interface, protocol and data format.

UNIT -III

12

Image and Graphics: Principles of raster graphics: visual display concept, resolution, colors and pallets, refresh rate and graphics accelerators; digital image representation and format, graphic drafting tools, image enhancement, colour printer principles, image scanner principles, digital still camera principles, file formats.

UNIT-IV

12

Video Technology: Analog video principles and broadcast standards, CCD Camera, recording formats and standard; digital video principles, TV cards, frame grabber principles, IDTV and HDTV principles Animation and Special Effects: History of animation, animation principles, animation techniques, shockwave animation, survey of animation tools and file formats, special visual effects.

UNIT -V

12

Storage Media: Magnetic media principles and storage density, principles of CD technology: CDROM, CDRW and CDDA format and principles, IDE, SCSI and USB interfaces to storage devices. **Data Compression:** Information theory based and frequency domain based compression, basic compression techniques (DPCM, RLE, Huffman Coding etc), JPEG/ISO, H261, H263, MPEG-1, 2, 4, 7, DVI. **Multimedia Document Interchange Formats:** Hypertext, HTML, MHEG, SGML, Open Document Architecture, Open Media Framework. **Authoring Tools and Metaphors:** Authoring tools: Productivity and Creativity, survey of authoring tools: book metaphor, slideshow metaphor, time-line metaphor, network and icon metaphor.

TOTAL HOURS: 60

TEXT BOOKS:

1. Tay Vahun, "Multimedia Making It Work, Eighth Edition, Tata McGraw Hill, 2010.
2. R. Steinmetz and K. Nashtedt, "Multimedia Computing, Communication & Applications", PHI, 2009.

REFERENCES:

1. Vic Costello, "Multimedia Foundations", British Library 2012.
2. Buford K., "Multimedia Systems", Pearson Education, 2010.

L	T	P	C
3	1	0	4

Course Objectives:

- To understand the mathematical foundations of security principles
- To appreciate the different aspects of encryption techniques
- To understand the role played by authentication in security
- To appreciate the current trends security practices

Course Outcomes:

- CO1: Understand different realizations of *multimedia* tools and their usage.
- CO2: Implement various multimedia standards and compression technologies.
- CO3: Analyze various storage technologies.

Pre-requisites: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

12

INTRODUCTION AND MATHEMATICAL FOUNDATION

An illustrative communication game – safeguard versus attack – Probability and Information Theory - Algebraic foundations – Number theory.

UNIT II

12

ENCRYPTION – SYMMETRIC TECHNIQUES

Substitution Ciphers – Transposition Ciphers – Classical Ciphers – DES – AES – Confidentiality Modes of Operation – Key Channel Establishment for symmetric cryptosystems.

UNIT III **12**

ENCRYPTION – ASYMMETRIC TECHNIQUES AND DATA TECHNIQUES

Diffie-Hellman Key Exchange protocol – Discrete logarithm problem – RSA cryptosystems & cryptanalysis – ElGamal cryptosystem – Need for stronger Security Notions for Public key Cryptosystems – Combination of Asymmetric and Symmetric Cryptography – Key Channel Establishment for Public key Cryptosystems - Data Integrity techniques – Symmetric techniques - Asymmetric techniques

UNIT IV

AUTHENTICATION **12**

Authentication Protocols Principles – Authentication protocols for Internet Security – SSH Remote logic protocol – Kerberos Protocol – SSL & TLS – Authentication frame for public key Cryptography – Directory Based Authentication framework – Non - Directory Based Public-Key Authentication framework.

UNIT V

SECURITY PRACTICES **12**

Protecting Programs and Data – Information and the Law – Rights of Employees and Employers – Software Failures – Computer Crime – Privacy – Ethical Issues in Computer Security.

TOTAL PERIODS: 60

TEXT BOOKS:

1. William Stallings, “Cryptography and Network security: Principles and Practices”, Pearson/PHI, 5th Edition, 2010.
2. Behrouz A. Forouzan, “Cryptography and Network Security”, 2nd Edition, Tata McGraw Hill Education, 2010.
3. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd Edition, Pearson, 2007.
4. Douglas R. Stinson, “Cryptography Theory and Practice”, 3rd Edition, Chapman & Hall/CRC, 2006.

REFERENCES:

1. Charlie Kaufman, Radia Perlman and Mike Speciner, “ Network Security Private Communication in a Public World”, PHI, Second Edition, 2012.
2. W. Mao, “Modern Cryptography Theory and Practice”, Pearson Education, 2nd Edition, 2007.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger, “Security in computing”, 3rd Edition, Prentice Hall of India, 2006.
4. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 2006.

L	T	P	C
3	1	0	4

Course Objectives:

- To build web applications using ASP and client side script technologies use with Microsoft's IIS.
- To build XML applications with DTD and style sheets that span multiple domains ranging from finance to vector graphics to genealogy for use with legacy browsers.

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Create richly interactive environments natively within browsers.

CO2: Build web application frameworks which facilitate rapid application development.

CO3: Integrate web applications easily into other server-side web procedures, such as email and searching.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S				M		M			
CO2	S		S		M					M	S	
CO3	S		M		M					M		S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT - I**FUNDAMENTALS****12**

Introduction to the Web-Web enabling Technologies-Web Service Protocol-web Design Concepts- Examining Good and Bad Web Design-Page Design Resources.

UNIT – II**SIMPLE DESIGN ISSUES****12**

Page Design-HTML-Web Page Style Considerations-Page composition-Type Faces-Tag Parameters-Color and Graphics for web Pages-WYSIWYG web Page Editor-Dream Weaver.

UNIT - III

ADVANCE DESIGN ISSUES

12

Advanced Page Design-Tables and Frames-Preparing Graphics and animations Forms-Cascading Sheets-User interface Design-Page grid-Page Templates-Usability Testing.

UNIT - IV

SCRIPTING IN DESIGN

12

Typography and Graphic Design for the Web-Creating Transparent GIF- Lean Graphics-Image Maps-Palette Map-web Programming-Web Site Garage-W3C HTML Validation Services-Net Mechanic-DHTML-XML.

UNIT - V

TOOLS AND APPLICATIONS

12

Online Applications-Developing an Online Shopping application-Database Design Issues-Connecting Database with tools such as Java, ASP, Cold fusion-Designing Portals and Vortals.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Deitel and Deitel, "Internet and World Wide Web-How to Program", 3rd Edition, Pearson Education, 2005.

REFERENCES:

1. N.P.Gopalan & J.Akilandeswari, "Web Technology: A Developer's Perspective", PHI Learning, 2008.
2. Jeff Frantzen and Sobotka, "Java Script", Tata McGraw Hill, 2002.
3. Justin Hunter,William Crawford, "Java Servlet Programming", O'Reilly Publications, 2nd Edition, 2001.
4. DHTML, O' Reiley Publications, 2000.

L	T	P	C
3	1	0	4

Course Objectives:

- To have an awareness about role of IT in business.
- To have knowledge of basic concepts of ecommerce.
- To have in depth knowledge in security and legal issues in ecommerce.

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Create and refine website and application designs based on industry's usability standards.

CO2: Assess the suitability of various design principles for websites and applications

CO3: Apply the skills necessary for large-scale project development on the Web

CO4: Apply the technologies required to design and prototype Web-based information systems.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S	S	M				M	S		M
CO2		M			S		S			S		S
CO3		S			M					M		S
CO4	S				S					M	M	S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT-I**12****ELECTRONIC COMMERCE**

Electronic Commerce, Electronic Data Interchange (EDI), E-Commerce Types – PC and networking; Networking, Communication media – Computer Communication Systems; ISO

model, Electronic mail, X.400 Message Handling System, E-mail security, Light weight directory access protocol – Internet: Introduction, Communication protocols, Issues of concern.

UNIT-II **12**

ELECTRONIC DATA INTERCHANGE

EDI: Introduction, Cost and Benefits, Components of EDI System, Implementation Issues – UN/EDIFACT Standard: Introduction, An EDIFACT Message, Interchange Structure, Message Directories - EDI Over Internet, Commerce Over Extranets, Identification and Tracking Tools.

UNIT-III **12**

REENGINEERING

Business process reengineering – Approach to BPR, BPR methodology – Change management: Change management in the Government, Implementation plan.

CONCERNS FOR E-COMMERCE GROWTH

Legal issues, Risks: Paper document versus electronic document, Technology for authenticating an electronic document, Laws for e-commerce, EDI interchange agreement.

UNIT-IV **12**

CYBER SECURITY: Cyber Attacks, Hacking, Firewalls, IDS, Secure Sockets Layer, Symmetric and asymmetric crypto systems, Guidelines for Cryptography Policy, Developing a Security Policy.

CYBER CRIMES: Cyber crimes and the Information Technology Act, 2000, Cyber forensics.

UNIT-V **12**

CASE STUDIES

E-Commerce: Case Studies: ITC's e-Choupal - E-Governance: Case Studies: Indian customs EDI System, Indian Railways, Government of Andhra Pradesh – eSeva.

COMPUTER EMERGENCY RESPONSE TEAM (CERT): Introduction, CERT-In, CERT-In Activities

TOTAL PERIODS: 60

TEXT BOOKS:

1. Kamlesh K Bajaj, Debjani Nag, "E-Commerce – The Cutting Edge of Business", Tata McGraw Hill, Second Edition, 2006.
2. David Whitley, "E-Commerce: Strategy, Technologies and applications", McGraw Hill, 2000.

REFERENCE:

1. Ravi Kalakota and Andrew B. Whinston, "Frontiers of Electronic commerce", Pearson Education, 2005.

L	T	P	C
3	1	0	4

Course Objectives:

- At the end of the course the students would be able to
- Understand the fundamentals of speech processing
- Understand the basics of Speech Models

Course Outcomes:

After successful completion of this course, students should be able to

CO1: Students understand the advanced features of databases in design, administration, and applications

CO2: Aspires to improve the performance of a database

CO3: Students learn about optimization of existing resources usage within the database environment.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M				M			S		M
CO2		M	S		M		M			S		S
CO3					M					M		S

- **Course Assessment methods:**

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I**12****FUNDAMENTALS OF SPEECH PROCESSING**

Introduction to Speech processing - applications - Fundamentals of speech processing - Analysis tools - z - Fourier - DFT transforms - FIR - IIR filters - sampling.

UNIT- II **12**

SPEECH MODELS

Digital models - Vocal tract analog and digital models - Time Domain models - Useful Performance measures - zero - crossings - voiced - unvoiced - pitch periods - correlation Functions - smoothing.

UNIT III **12**

DIGITAL REPRESENTATION AND ANALYSIS

Digital representations of speech waveform - Encoding of speech using delta modulation - PCM - differential PCM - other systems - Short-time Fourier analysis - Short term analysis Effects - filter banks - pitch detection - vocoders.

UNIT- IV **12**

HOMOMORPHIC SPEECH PROCESSING AND LINEAR PREDICTIVE CODING

Homomorphic speech processing - Cepstrum - pitch detection - formant estimation - vocoders - Linear predictive coding of speech - LPC methods and parameters - relations between speech parameters.

UNIT -V **12**

DIGITAL SPEECH PROCESSING AND RECOGNITION

Digital speech processing for man - machine communication by voice - Speech and speaker recognition - voice response systems.

TOTAL PERIODS: 60

TEXT BOOKS :

1. Amy Neustein, "Advances in Speech Recognition" Springer, 2010.
2. Claudio, Klucio, "Speech Recognition", Wiley 2008

REFERENCES:

1. Dorothea Kolossa, Reinhold Haeb-Umbach,, "Robust Speech Recognition of Uncertain or Missing Data: Theory and Applications", Springer, 2011.
2. Wai C. Chu, "Speech Coding Algorithm", Wiley, 2004.

L	T	P	C
3	1	0	4

Course Objectives:

- Review theoretical background covering multicore processor architecture, concurrent programming, and parallel programming concepts and considerations.
- Cover critical concepts such as implicit and explicit parallelism, atomicity, synchronization, shared memory, cache coherency, Amdahl's Law, Flynn's processor classifications, and Little's law in detail.
- Recognize the best parallelism opportunities and explain the advantages of using threads to obtain concurrency using various analysis techniques, compositional approaches, and parallel design patterns.
- Learn how to avoid synchronization pitfalls such as starvation, deadlock, live lock, and data races.

Course Outcomes:

After successful completion of this course, students should be able to

- CO1: Understand and use threads with specific technologies and programming methods, such as the Windows API, POSIX pthreads, Intel TBB, and Open MP using C/C++ and the Intel Compiler.
- CO2: Gain hands-on experience with the Intel Compiler to build and run multithreaded programs during the laboratories.
- CO3: Learn best practices to deal with MT-unsafe libraries and how to write new thread-safe libraries.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S		S	S	M				M		M
CO2		S	M					M				
CO3		S		M		M					M	M

• **Course Assessment methods:**

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I **12**

Fundamentals of SuperScalar Processor Design, Introduction to Multicore Architecture – Chip Multiprocessing, homogeneous Vs heterogeneous design - SMP – Multicore Vs Multithreading.

UNIT -II **12**

Shared memory architectures– synchronization – Memory organization – Cache Memory – Cache Coherency Protocols - Design of Levels of Caches.

UNIT- III **12**

Multicore programming Model – Shared memory model, message passing model, transaction model – OpenMP and MPI Programming.

UNIT -IV **12**

PowerPC architecture – RISC design, PowerPC ISA, PowerPC Memory Management Power 5 Multicore architecture design, Power 6 Architecture.

UNIT -V **12**

Cell Broad band engine architecture, PPE (Power Processor Element), SPE (Synergistic processing element), Cell Software Development Kit, Programming for Multicore architecture.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.
2. Wesley Petersen and Peter Arbenz, “Introduction to Parallel Computing”, Oxford University Press, 2004.

REFERENCES:

1. John L. Hennessey and David A. Patterson, “ Computer architecture – A quantitative approach”, Morgan Kaufmann/Elsevier Publishers, 4th edition, 2007.
2. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture : A hardware/ software approach” , Morgan Kaufmann/Elsevier Publishers, 2004.
3. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.

L	T	P	C
3	1	0	4

Course Objectives:

- To impart knowledge on probability concepts to study their applications in stochastic processes & queuing theory

Course Outcomes:

After successful completion of this course, students should be able to

- CO1: Compute the characteristics of the random variable given the probabilities
 CO2: Understand and apply various distribution
 CO3: Solve cases of different Stochastic processes along with their properties.
 CO4: Use discrete time finite state Markov chains
 CO5: Gain sufficient knowledge in principles of queuing theory

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S				M				S
CO2	S	S		S								M
CO3	S	S		S	M							S
CO4	S	S		S					M			M
CO5	S	S		S		M						S

- Course Assessment methods:**

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

RANDOM VARIABLES

One dimensional and two dimensional Random Variables – Characteristics of Random Variables :Expectation, Moments.

12

UNIT II

THEORETICAL DISTRIBUTIONS

Discrete : Binomial, Poisson, Negative Binomial, Geometric, Uniform Distributions.
Continuous: Uniform, Exponential, Erlang and Gamma, Weibull Distributions.

UNIT III **12**

STOCHASTIC PROCESSES

Classification of Stochastic Processes – Bernoulli process – Poisson process – Pure birth process – Birth and Death process.

UNIT IV

MARKOV CHAINS **12**

Introduction – Discrete-Parameter Markov Chains – Transition Probability Matrix – Chapman Kolmogorov Theorem – State classification and limiting distributions.

UNIT V **12**

QUEUING THEORY

Introduction – Characteristics of Markovian Single server and Multi server queuing models [(M/M/1) : (∞ / FIFO), (M/M/1) : (N / FIFO), (M/M/s) : (∞ /FIFO)] – M/G/1 Queuing System – Pollaczek Khinchin formula.

TEXT BOOKS:

1. Kishore.S.Trivedi, “Probability & Statistics with Reliability, Queuing and Computer Science Applications”, PHI, New Delhi, 2008.
2. Veerajan T, “Probability, Statistics and Random Processes”, 3rd Edition Tata McGraw Hill, New Delhi, 2008.

REFERENCES:

1. Sundarapandian, “Probability, Statistics and Queuing Theory”, PHI,2009.
2. 1. Gupta S.C and Kapoor V.K, “Fundamentals of Mathematical Statistics”, 9th revised edition, Sultan Chand & Co., New Delhi 2003.

L	T	P	C
3	1	0	4

Course Objectives:

- To learn real time operating system concepts and the associated issues & techniques.
- To explain and apply the fundamental concepts and terminology of real-time systems;
- To explain and address the fundamental problems of real-time systems;
- To analyze real-time systems designs;
- To design a real-time system (at least partially); and
- To identify and assess the relevant literature and research trends of real-time systems.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1:To present the mathematical model of the system.

CO2:To develop real-time algorithm for task scheduling.

CO3:To understand the working of real-time operating systems and real-time database.

CO4:To work on design and development of protocols related to real-time communication.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									S
CO2	S	M	S	M								S
CO3	S	M	S									S
CO4	S	S	S	M								S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

REAL TIME SPECIFICATION AND DESIGN TECHNIQUES

12

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II

REAL TIME SPECIFICATION AND DESIGN TECHNIQUES

12

Natural languages – mathematical specification – flow charts – structured charts – pseudocode and programming design languages – finite state automata – data flow diagrams – petrinets – Warnier Orr notation – state charts – polled loop systems – phase / state driven code – co routines – interrupt – driven systems – foreground/background system – full featured real time operating systems.

UNIT III

INTERTASK COMMUNICATION AND SYNCHRONIZATION

12

Buffering data – mailboxes – critical regions – semaphores – deadlock – process stack management – dynamic allocation – static schemes – response time calculation – interrupt latency – time loading and its measurement – scheduling is NP complete – reducing response times and time loading – analysis of memory requirements – reducing memory loading – I/O performance.

UNIT IV

REAL TIME DATABASES

12

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V

EVALUATION TECHNIQUES

12

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Samarjit Chakraborty, Jorg Eberspacher,” Advances in Real Time Systems, Springer, 2012
2. C.M. Krishna, Kang G. Shin, “Real Time Systems”, McGraw Hill “, 2010.
3. Rajib Mall, ”Real-time systems: theory and practice”, Pearson Education, 2007.

REFERENCES:

1. Philip.A.Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 3rd Edition, April 2004.
1. Allen Burns, Andy Wellings, “Real Time Systems and Programming Languages”, Pearson Education, 2003.

MC142 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

Course Objectives:

- To develop analytical capability and to impart knowledge in graphs, linear programming problem and statistical methods and their applications in Engineering & Technology
- To apply their concepts in engineering problems they would come across

Course Outcome:

After successful completion of this course, the students should be able to

CO 1: To develop analytical capability and to impart knowledge in graphs, linear programming problem and statistical methods and their applications in Engineering & Technology

CO 2: Students should be able to apply the concepts in solving the Engineering problems

Pre-requisites: Nil**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I**12****BASICS OF GRAPH THEORY**

Graphs - Data structures for graphs – Sub graphs - Operations on Graphs Connectivity – Networks and the maximum flow - Minimum cut theorem - Trees - Spanning trees - Rooted trees – Matrix representation of graphs.

UNIT II **12**

CLASSES OF GRAPHS

Eulerian graphs and Hamiltonian graphs - Standard theorems - Planar graphs - Euler's formula - Five colour theorem - Coloring of graphs - Chromatic number (vertex and edge) properties and examples - Directed graphs.

UNIT III- **12**

GRAPH ALGORITHM

Computer Representation of graphs - Basic graph algorithms - Minimal spanning tree algorithm - Kruskal and Prim's algorithm - Shortest path algorithms - Dijkstra's algorithm - DFS and BFS algorithms.

UNIT IV **12**

OPTIMIZATION TECHNIQUES

Linear programming – Graphical methods – Simplex method (Artificial variables not included) – Transportation and assignment problems.

UNIT V **12**

STATISTICS

Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", PHI, 2004.

REFERENCES :

1. R. Balakrishnan, K. Ranganathan, "A Textbook of Graph Theory", Springer, 2012.
2. Ashay Dharwadkar, Shariefuddin Pirzada, "Graph Theory", 2011
2. G. Suresh Singh, "Graph Theory", PHI, 2010.

**MCS143 FUZZY AND GENETIC
ALGORITHM**

L	T	P	C
3	1	0	4

Course Objectives:

- To introduce the ideas of Neural Networks, fuzzy logic and use of heuristics based on human experience.
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1: Learn the unified and exact mathematical basis as well as the general

CO 2: Principles of various soft computing techniques.

CO 3: Provide detailed theoretical and practical aspects of intelligent

CO 4: Modeling, optimization and control of non-linear systems.

CO 5: Prepare the students for developing intelligent systems through case

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S								
CO2	S	M	S	S								
CO3	M	S		S								
CO4	S	S		S								
CO5	S	S	M	S								

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT-I

12

INTRODUCTION:

Uncertainty and Imprecision-Statistics and Random process - Uncertainty in information - Fuzzy sets and Membership - Chance versus ambiguity, classical Sets and Fuzzy Sets : Classical Sets - Fuzzy sets - Sets as points in hypercube, Classical Relations and Fuzzy Relations Cartesian product -Crisp Relations - Fuzzy Relations - Tolerance and Equivalence Relations - Value Assignments.

UNIT-I I **12**

Membership Functions: Features of Membership function - Standard forms and boundaries – Fuzzification - Membership value assignments. -Fuzzy to Crisp conversions: Lambda cuts for fuzzy sets - Lambda cuts for fuzzy relations- Defuzzification Methods.

UNIT-III **12**

Fuzzy Arithmetic, Numbers, Vectors and the Extension Principle: Extension Principle- Fuzzy numbers - Internal analysis in arithmetic - Approximate methods of extension. Classical logic and fuzzy logic: Classical predicate logic - Fuzzy logic - Approximate reasoning - Fuzzy Tautologies - Other forms of the implication & composition operation.

UNIT-IV **12**

Fuzzy Rule Based Systems: Natural language - Linguistic hedges - Rule based systems - Graphical techniques of inference, Fuzzy Nonlinear Simulation: Fuzzy Relational Equations - Partitioning - Nonlinear Simulation using fuzzy rule based systems - FAMs. Fuzzy decision making.

UNIT-V **12**

Fuzzy Classification: Classification by equivalence relations- Cluster analysis - Cluster validity - Classification metric - Hardening the fuzzy - Partition, Fuzzy Pattern Recognition : Feature analysis-Partitions of the feature space - Single sample identification - Image processing syntactic recognition.

TOTAL PERIODS: 60

TEXT BOOKS

1. S. Rajasekaran and G.A.V.Pai, ,”Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2011.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Edition 2009.

REFERENCE

1. J. Harris,”An Introduction to Fuzzy Logic Applications”, Springer, 2001

L	T	P	C
3	1	0	4

Course Objectives:

- The course provides details about the modern component platforms.
- Based on practical examples, details about modern middleware technologies will be analyzed.
- Students get the chance to gain in-depth knowledge about their favorite middleware platform.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Thoroughly, individually, describe the most important aspects when using middleware technologies

CO2: Be able to, in group, develop a component-based application based on middleware technology.

CO3: Be able to individually judge existing or new middleware frameworks in comparison to historical and today's solutions

CO4: Individually, in detail describe differences and similarities in different middleware platforms.

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	M		M								
CO3	S	M										
CO4		S	M	M								

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I **12**

CLIENT / SERVER CONCEPTS

Client – Server – File Server, Database server, Group server, Object server, Web server
.Middleware – General middleware – Service specific middleware. Client / Server Building
blocks – RPC – Messaging – Peer – to- Peer.

UNIT II **12**

EJB ARCHITECTURE

EJB – EJB Architecture – Overview of EJB software architecture – View of EJB –
Conversation – Building and Deploying EJBs – Roles in EJB.

UNIT III **12**

EJB APPLICATIONS

EJB Session Beans – EJB entity beans – EJB clients – EJB Deployment – Building an
application with EJB.

UNIT IV **12**

CORBA

CORBA – Distributed Systems – Purpose - Exploring CORBA alternatives – Architecture
overview – CORBA and networking model – CORBA object model – IDL – ORB - Building
an application with CORBA.

UNIT V **12**

COMPONENT OBJECT MODEL

COM – Data types – Interfaces – Proxy and Stub – Marshalling – Implementing Server /
Client – Interface Pointers – Object Creation, Invocation , Destruction – Comparison COM
and CORBA – Introduction to .NET – Overview of .NET architecture – Marshalling -
Remoting.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Robert Orfali, Dan Harkey and Jeri Edwards, “The Essential Client/Server Survival Guide”, Galgotia Publications Pvt. Ltd., 2002.
2. Tom Valesky, “Enterprise Java Beans”, Pearson Education, 2002.

REFERENCES:

1. Jesse Liberty, “Programming C#”, 2nd Edition, O’Reilly Press, 2002.
2. Mowbray, “Inside CORBA”, Pearson Education, 2002.
3. Jason Pritchard, “COM and CORBA side by side”, Addison Wesley, 2000.

L	T	P	C
3	1	0	4

Course Objectives:

- Determine the need for computers and evaluate the use of computers,
- identify the stages in software engineering that need to be modified for effectiveness of interacting with computers
- discover the various models that can be used for designing systems
- evaluate the design techniques by applying the apt statistical approach
- Design dialogue for representation to computers

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the human components functions regarding interaction with computer

CO2: Explain Computer components functions regarding interaction with human

CO3: Demonstrate Understanding of Interaction between the human and computer components.

CO4: Use Paradigms

CO5: Implement Interaction design basics

CO6: Use HCI in the software process

CO7: Apply Design rules

CO8: Produce Implementation supports

CO9: Use Evaluation techniques

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S								
CO2	S	S		S								
CO3	S	S		S						S		
CO4	S	S		S								
CO5	S	S		S								
CO6	S	S		S	M							
CO7	S	S		S								
CO8	S	S		S								
CO9	S	S		S	M							

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. Model Exam 6. End Semester Exam	1. Attitude 2. Behavior

UNIT I**DESIGN PROCESS****12**

Humans – Information process – Computer – Information Process – Differences and Similarities between them – Need for Interaction – Models – Ergonomics – Style – Context – Paradigms – Designing of Interactive systems – Usability – Paradigm shift – Interaction design basics – Design Process – Scenarios – Users need – Complexity of design

UNIT II**12****DESIGN AND EVALUATION OF INTERACTIVE SYSTEMS**

Software Process – Usability engineering – Issue based Information systems – Iterative design practices – Design rules – maximum usability – Principles – Standards and guidelines – design patterns – Programming Tools – Windowing systems – Interaction tool kit – User Interface management system – Evaluation techniques – evaluation design – Evaluating implementations – Observational Methods .

UNIT III**MODELS****12**

Universal design principles – Multimodal systems – User Support – Presentation and Implementation Issues – types – requirements – approaches – Cognitive model – Hierarchical model – Linguistic model – physical and device models – Socio-technical models – Communication and Collaboration models – Task models – Task analysis and design.

UNIT IV**12****EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS OF HCI**

Basic Design structure – Single independent variable – multiple independent variable – factorial design – split-plot design – random errors – experimental procedure – Statistical analysis.

T tests – Analysis of Variance test – Regression – Chi-Square test – Survey – Probabilistic sampling – Non-probabilistic sampling – developing survey questions

UNIT V**12**

THEORIES Dialogue notations and design – Dialogue need – dialogue design notations – Graphical – Textual - representing dialogue – formal descriptions – Dialogue analysis – System models – Interaction models – relationship with dialogue – Formalisms – Formal notations – Interstitial behavior – Virtual reality – Modeling rich interaction – Status Event analysis – Properties – Rich contexts – Sensor-based systems – Groupware – Applications – Ubiquitous computing – Virtual reality

TOTAL PERIODS: 60**TEXT BOOKS:**

1. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, “Research Methods in HumanComputer Interaction”, Wiley, 2010.
2. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale “Human Computer Interaction”, 3rd Edition Prentice Hall, 2004.

REFERENCE:

1. Ben Shneiderman and Catherine Plaisant “Designing the User Interface: Strategies for Effective Human-Computer Interaction “,Addison-Wesley ,5th Edition,2009.

L	T	P	C
3	1	0	4

Course Objectives:

- To introduce the concept of distributed component architectures, including its relationship to the object-oriented programming paradigm.
- To demonstrate the importance of reusability and focuses on design pattern and frameworks in distribute component architecture.
- To introduce different component frameworks, including Enterprise Java Beans, COM, CORBA, Web Services and discuss interoperability.
- Between applications built in different frameworks using .NET.
- To present primary issues in component frameworks, including events
- properties, introspection and reflection, persistence, and packaging will be thoroughly reviewed.
- To describe software architecture and its evaluation mechanism for supporting components and theoretical foundations of components

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the human components functions regarding interaction with computer

CO2: Explain Computer components functions regarding interaction with human

CO3: Demonstrate Understanding of Interaction between the human and computer components.

CO4: Use Paradigms

CO5: Implement Interaction design basics

CO6: Use HCI in the software process

CO7: Apply Design rules

CO8: Produce Implementation supports

CO9: Use Evaluation techniques

Pre-requisites: Nil

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S				M	M	S	M	M	S
CO2			S					S	S	M		
CO3			S				M	M	S		M	
CO4			S					M	S	M		M
CO5			S				M	M	S			M

CO6		S	S			M			S			
CO7			S	M			S		S			
CO8			S						M			S
CO9					M						M	

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	1. Attitude 2. Behavior

UNIT I **12**

BASIC CONCEPTS

Software Components - Component models and Component Services-myths in Component Based Technology - Risk Factors - Success Factors, Component Based Software Development.

UNIT II **12**

COMPONENTS, ARCHITECTURE AND PROCESS

Component Architecture, Component Frameworks, Component Development, Component distribution and acquisition, Component assembly, markets and components.

UNIT III **12**

DESIGN OF SOFTWARE COMPONENT

Software Components and the UML Component Infrastructures - Business Components - Components and Connectors - Designing Models of Modularity & Integration

UNIT IV **12**

MANAGEMENT OF COMPONENT BASED SOFTWARE SYSTEMS

Measurement and Metrics for Software Components - Selecting the right Components - Software Component Project Management - Trouble with Testing Components - Configuration Management and Component Libraries - Evolution Maintenance of Management of Component based Systems.

UNIT V **12**

COMPONENT TECHNOLOGIES

Overview of the Following Component Models: CORBA, COM+, Enterprise Java Beans, Software Agents.

TOTAL HOURS: 60

TEXT BOOKS:

1. 1.Clemens Szyperski, "Component Software - Beyond object oriented programming", Pearson Education, 2nd edition, 2004.
2. 2.GeorgeT.Heinemen, William T. Councill, "Component Based Software Engineering",2001.

REFERENCES:

1. Thomas J..Mowbray, William A.Ruh, "Inside CORBA Distributed Object Standards and Applications", Addison - Wesley, 2001.
2. Dale Rojerson, "Inside COM", Microsoft Press, 2001.
3. Andreas Vogel, Keith Duddy "Java Programming with CORBA" John Wiley & Sons,3rd edition,2001.

L	T	P	C
3	1	0	4

Course Objectives:

- To provide hardware and software issues in modern distributed systems.
- To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
- To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1:To provide hardware and software issues in modern distributed systems.

CO2:To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3:To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S									S
CO2		S	S	M								S
CO3	S	M	S									S

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I**12**

Modes of communication, System Process, Interrupt Handling, Handling Systems calls, Protection of resources &Resources Management Micro-Kernel Operating System.

UNIT II **12**

Review of Network Operating System and Distributed Operating System, Issue in the design of Distributed Operating System, Overview of Computer Networks. Inter process communication, Linux, IPC Mechanism, Remote Procedure calls, RPC exception handling, security issues, RPC in Heterogeneous Environment (case study Linux RPC)

UNIT III **12**

Clock Synchronization, Logical clocks, Physical clocks, clock synchronization algorithms, Mutual Exclusion, Election Algorithms, Dead locks in Distributed Systems. Thrashing, Heterogeneous DSM, Resource Management (Load Balancing approach, Load Sharing approach), Process Management: process Migration, Thread.

UNIT IV **12**

Overview of shared memory, consistency model, Page based Distributed Shared Memory, Shared –variable Distributed Memory, Object -based Distributed Memory.

UNIT -V **12**

File models, File access, File sharing, file-caching, File Replication, fault Tolerance, Network File System, (Case study, 8NFS on Linux Directory Services, Security in Distributed File system).

TOTAL PERIODS: 60

TEXT BOOKS:

1. M. Beck et al,” Linux Kernal Programming”,3rd edition, 2002.
2. B.W. Kernighan and R Pide, “The Unix Programming Environment “,Prentice Hall of India-2000.

REFERENCE:

1. Silberschatz,P.B.Garvin,Gagne,” Operating System Concepts”, 2009.

MCS148 EMBEDDED SYSTEM

L	T	P	C
3	1	0	4

Course Objectives:

- To study the software designing used in embedded systems.
- To study the object oriented analysis and design for real time systems.
- To study the development activities of real time system using UML.

Course Outcomes:

CO1: Apply Object Structure and Behavior analysis in real time design

CO2: Apply the concept of architectural design in practical applications

CO3: Apply objects and classes concepts in real time applications

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S							S				
CO2	S	M		M				S				
CO3	S	M						S				M

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I**12****REVIEW OF EMBEDDED HARD WARE**

Gates - Timing Diagram - Memory - Microprocessor - Buses - Direct Memory Access - Interrupts - Built ins on the Microprocessor - Convention Used on Schematic - Schematic - Interrupts Microprocessor Architecture - Interrupt Basics - Shared Data Problem - Interrupt Latency.

UNIT- II **12**

MICROCHIP PIC MICRO CONTROLLER

Introduction - CPU Architecture - Registers - Instruction Sets - Addressing Modes - Loop Timing - Timers - Interrupts Timing - I/O Exception - I2 C Bus Operation - Serial EEPROM - Analog to Digital Converter - UART - Baud Rate - Data Handling - Initialization - Special features - Serial Programming - Parallel Slave Port.

UNIT- III **12**

EMBEDDED MICROCOMPUTER SYSTEM

Motorola MC68H11 Family Architecture - Registers - Addressing Modes Programs - Interfacing Methods - Parallel I/O Interface - Parallel Port Interface - Memory Interfacing - High Speed I/O Interfacing - Interrupts- Interrupt Service Routine - Features of Interrupts - Interrupt Vector - Priority - Timing Generation & Measurement - Input capture - Output Compare - Frequency measurement - Serial I/O Devices - RS 232, RS485 - Analog Interfacing - Applications.

UNIT -IV **12**

SOFTWARE DEVELOPMENT

Round Robin - Round Robin with Interrupts - Function - Queue Scheduling Architecture & Algorithms - Introduction to - Assemblers, Compilers, Cross Compilers, Integrated Development environment(IDE) - Object Oriented Interfacing - Recursion - Debugging Strategies - Simulators .

UNIT -V **12**

REAL TIME OPERATING SYSTEM

Task & Task States - Tasks & Data - Semaphores & Shared Data - Operating System Services - Message Queues - Timer Functions - Event Memory Management - Interrupt Routines & RTOS Environment - Basic design Using RTOS.

TOTAL PERIODS: 60

TEXT BOOKS:

1. David E. Simon, "An Embedded Software Primer", Pearson Education, 2004
2. Jonarthan W. Valvano, "Embedded Micro Computer System: Real Time Interfacing", Thomson Learning, 2001.

REFERENCES:

1. Laplante,Ovaska,"Real-Time Systems Design and Analysis: Tools for the Practitioner", 4th Edition,Wiley,2013.
2. Bruce Schneier, Niels Ferguson, "Practical Cryptography", Wiley Dream tech India Pvt. Ltd., 2003.

MCS149 SPEECH TECHNOLOGY

L	T	P	C
3	1	0	4

Course Objectives:

- To provide knowledge in fundamentals of speech processing
- To get knowledge in speech models.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: The student will gain enough understanding of speech models

CO2: The student will understand and estimate the impact of different digital speech recognition models

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2		M	S							S		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I**12****FUNDAMENTALS OF SPEECH PROCESSING**

Introduction to Speech processing - applications - Fundamentals of speech processing - Analysis tools - z - Fourier - DFT transforms - FIR - IIR filters - sampling.

UNIT II**12****SPEECH MODELS**

Digital models - Vocal tract analog and digital models - Time Domain models - Useful Performance measures - zero - crossings - voiced - unvoiced - pitch periods - correlation Functions - smoothing.

UNIT III **12**

DIGITAL REPRESENTATION AND ANALYSIS

Digital representations of speech waveform - Encoding of speech using delta modulation - PCM - differential PCM - other systems - Short-time Fourier analysis - Short term analysis Effects - filter banks - pitch detection - vocoders.

UNIT IV **12**

HOMOMORPHIC SPEECH PROCESSING AND LINEAR PREDICTIVE CODING

Homomorphic speech processing - Cepstrum - pitch detection - formant estimation - vocoders - Linear predictive coding of speech - LPC methods and parameters - relations between speech parameters.

UNIT V **12**

DIGITAL SPEECH PROCESSING AND RECOGNITION

Digital speech processing for man - machine communication by voice - Speech and speaker recognition - voice response systems.

TOTAL PERIODS: 60

TEXT BOOKS:

1. L. R. Rabiner & R. W. Schafer, "Digital Processing of Speech Signals", Prentice Hall, 2008.
2. Amy Neustein, "Advances in Speech Recognition" Springer, 2010.
3. Claudio Klucio, "Speech Recognition", Wiley 2008

REFERENCES:

1. Wai C. Chu, "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", John Wiley & Sons, 2003.
2. Javier Ramírez, Juan Manuel Górriz, "Recent Advances in Robust Speech Recognition Technology", 2011.

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3	1	0	4

MCS150 INFORMATION TECHNOLOGY AND CYBER LAWS

Course Objectives:

- To provide with a thorough understanding of the issues associated with the design, provision and management of security services for information systems.
- To learn the different aspects of information security, security attacks and the defense strategies used to combat them.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Describe the fundamental concepts of information system security cyber laws

CO2: Understand the basic security terms such as encryption, authentication, firewall and intrusion detection.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S		M			M	S		
CO2	S	S		M					M	S		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I

12

Crimes of this millennium – checks and balances against arbitrary arrests –concept of cyber crime and the IT Act- Hacking – Teenage Web Vandals – Cyber Fraud and Cyber Cheating – Virus on the Internet-other IT Act offences – Network service providers-Criminal justice in India and Implications.

UNIT -II**12**

Contracts in the Infotech World – Click Wrap and Shrink Wrap contracts – contract formation under the Indian context – contract formation on the Internet – Terms and conditions of the Contract – jurisdiction and information technology act – foreign judgements in India – IPR disputes – misuse of the law of jurisdiction – jurisdictional disputes with respect to the internet in USA.

UNIT- III**12**

Concept of Domain Name and Reply to Cyber squatters – meta-tagging – copyright ownership and assignment – License of copyright – copyright term and respect for foreign works – copyright infringement remedies and offences – copyright protection of content on the Internet – computer software piracy

UNIT- IV**12**

Concept of permanent Establishment – PE in cross border E-Commerce - the United Nations model Tax treaty – law of double taxation avoidance agreements – Tax Agents of non-residents under the Income tax act and the relevance to E commerce – impact of the internet on customs duties – taxation policies in India

UNIT -V**12**

Digital signatures – Digital signature certificate – certifying authorities and liability in the event of Digital signature compromise – status of Electronic records as Evidence – proving Digital signatures – proof of Electronic agreements – proving electronic messages – goods and services – consumer complaint – defect in goods and deficiency in services restrictive and unfair trade –practices – reliefs under CPA – consumer for as, jurisdictions and implications on cyber consumers in.

TOTAL HOURS:60**TEXT BOOKS:**

1. R. K. Chaubey, “An Introduction to cyber crime and cyber law”, Kamal Law House, second edition 2012.
2. Vivek Sood, “Cyber law Simplified”, Tata McGraw Hill, 2001.

REFERENCES:

1. John W. Rittinghouse, William M. Hancock, “Cyber security Operations Handbook”, 2005.
2. John R. Vacca, “Computer forensics: Computer Crime Scene Investigation”, 2nd Edition, Charles River Media, Inc. Boston, 2005.

L	T	P	C
3	1	0	4

MCS151 PHP PROGRAMMING

Course Objectives:

- It gives all students exposure to basics of PHP
- It gives knowledge on session tracking and graphics using PHP

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Recognize the difference between HTML, XHTML, MySQL & PHP.

CO2 Differentiate between PHP Web & HTML Controls

CO3: Understand different Web controls

CO4: Understand connecting Web pages with DB.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	S			S	M		S	
CO2	M	S	S	M	S			S	M		S	
CO3	M	S	S	M	M			S	M		S	
CO4	S	S	S	M	S			S	M		S	

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT I

12

PHP Introduction: PHP Basics - Evolution of PHP - Introduction to PHP Programming Variables, Operators, and Constants: Introduction to Variables – Operators – Type Juggling - Type Casting - Variable Variables - function for Determining and Setting Variable- Types - Constants. Control Structures: Conditional Expressions- Arrays: Introduction to Arrays-

Initializing Arrays - Working with Arrays. Functions: Introduction to Functions - Passing Arguments to Functions - Returning Values from Functions - Understanding the Scope of a Variable within a Function, Variable Functions and Variable Argument Functions

UNIT II **12**

Understanding Classes: Classes – Constructors - Extending a class. Form Parsing in PHP: Parsing HTML Posted Values in PHP - Form Validation- Printing the Confirmation Page - Printing Hidden Fields - Putting Theory into Practice. Handling Files: Working with Files - Putting Theory into Practice.

UNIT III **12**

Handling Data Storage: An Introduction to Database Concepts - Database Management System - Relational Database Management System - Database Normalization - PHP Support to various Databases - Web Database Architecture -MySQL Database Programming. Using PHP with SQL Databases: Working with MySQL - Using Multiple Databases Simultaneously - Important PHP-MySQL Functions - Error handling in MySQL – Error Types in PHP - Creating Customized Error Handlers.

UNIT IV **12**

Session Tracking: An Overview of Sessions - Tracking Sessions. Input Validators in PHP: Validation Basics - Performing Validations in an HTML Web Page - Performing Validations in PHP - Functions for Validating User Input - Validating Email Addresses. Cookies: What Is a Cookie? Implementing Cookies in PHP - Are Cookies Harmful?

UNIT V **12**

Graphics in PHP: Graphics on the web - Creating Images in PHP. Understanding CVS: CVS an Overview – The CVS Repository – Environment Variables in CVS - CVS Command Options. PEAR: Introduction to PEAR – Coding Standards in PEAR – PEAR and CVS – Contributing Codes to PEAR – Requirements to Make Changes in PEAR – Help in PEAR.

TOTAL HOURS: 60

TEXT BOOKS:

1. Matt Doyle,” Beginning PHP 5.3”,Wiley,2011.
2. Ashish Wilfred,Meeta Gupta and Kartik Bhatnagar with NIIT, ”PHP Professional Projects”, Prentice Hall of India, 2002.

REFERENCES:

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf ,”Programming PHP”,O’Rielley,2013.
2. Rasmus Lerdorf and Kevin Tatroe, “Programming in PHP”, O’Reilly and Associates, 2002.

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MCS152 QUANTUM THEORY & ALGORITHM DESIGN

Course Objectives:

- It gives all students exposure to important concepts in quantum theory
- It gives knowledge in matrices, tensor products
- It gives knowledge in dynamic programming and various algorithms using data structure

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Understand Quantum Computing

CO2: Understand the Quantum theory algorithms

CO3: Understand how to apply algorithms using various data structure for real time applications

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S						M		
CO2	S	S	M	S						M		
CO3	S	S	M	S						M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT- I

12

Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt ortho gonalization, bracket formalism, the Cauchy-schwarz and triangle Inequalities.

UNIT -II **12**

Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators, Commutator Algebra, Heisenberg uncertainty principle, polar decomposition & singular values, Postulates of Quantum Mechanics.

UNIT -III **12**

Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices.

UNIT- IV **12**

Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.

Quantum Measurement Theory : Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.

UNIT -V **12**

Introduction Mathematics for Algorithmic: Sets, Functions and Relations. Amortized Analysis: Properties of Matrices, Solving systems of linear Equations, Linear programming, general linear programs, an overview of linear programming The Greedy Methods: Optimization problems, the greedy method, 0/1 knapsack problem, topological sorting, Single source shortest path, minimum cost spanning tree. Divide & Conquer: The method. Application: merge sort. Dynamic programming: The method, Application: 0/1 knapsack problem Skip lists and hashing. Priority Queues: Huffman Codes. Binary Search Trees: Binary search trees, indexed binary search trees, binary search tree operations and implementation. Graphs. Basic Data Structures: Tree, The tree Abstract Data type, Tree Traversal, Binary tree.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Zdzisław Meglicki, "Quantum Computing without Magic", The MIT Press, 2008.
2. David McMahon, "Quantum Computing Explained", Wiley, 2008.
3. Marco Lanzagorta, Jeffrey Uhlmann, "Quantum Computer Science", 2009.

REFERENCES:

1. Michael T. Goodrich, "Algorithm Design and Applications", Wiley, 2014.
2. Thomas H. Cormen, Leiserson, Rivest & Stein, "Introduction to Algorithms", 2009.
3. Phillip Kaye, Raymond Laflamme, Michele Mosca, "An Introduction to Quantum Computing", Oxford, 2007.

L	T	P	C
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Course Objectives:

- To provide an understanding of principal concepts, major issues, technologies, and basic approaches in information security.
- To provide concept-level hands-on experience in specific topic area.
- To provide the ability to examine and analyze real-life security cases.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Harden servers and clients.

CO2: Recognize common attack patterns.

CO3: Evaluate vulnerability of an information system and establish a plan for risk management

CO4: Demonstrate how to detect and reduce threats in Web security.

CO5: Evaluate the authentication and encryption needs of an information system.

CO6: Explain the Public Key Infrastructure process

CO7: Demonstrate how to secure a wireless network

CO8: Evaluate a company's security policies and procedures

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M				S				M		
CO2	M	S			S	S				M		
CO3	M	S			M	S				M		
CO4	M	M				S				M		
CO5	M	S			S	S				M		
CO6	M	S				S				M		
CO7	M	S			M	S				M		
CO8	M	S				S				M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT – I**12**

Cryptography and Data Security Information assurance issues -Threats to authentication, privacy and integrity, Generating MD5 hash collisions -Approaches to cryptography - Symmetric vs. asymmetric ciphers, Issues for secret key encryption

UNIT – II**12**

Public key fixes to secret key problems, Hashing and digital signatures, Generating and exchanging keys -Authentication via key ownership, Non-repudiation using digital signatures, Digital signatures in the real world, Key distribution and management, E-voting.

UNIT – III**12**

Intrusion Detection Overview, Host based intrusion detection systems, Network based intrusion detection systems, IDS as part of the overall Security System

UNIT – IV**12**

IDS Signatures and Analysis Schemes for Intrusion Detection Systems, Anomaly detection, Expert Systems, Tools for packet analysis and intrusion detection, Some intrusion detection tools (Snort, Windump, Ethereal etc.).

UNIT V**12**

Case Reports of various attack strategies, Implementation Issues , Future directions

TOTAL PERIODS: 60**TEXT BOOKS:**

1. William Stallings, “Cryptography and Network Security – Principles and Practices”, Prentice Hall of India, Third Edition, 2003.
2. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.

REFERENCES:

1. William Stallings; Network Security Essentials, Pearson publication, 2005.
2. William Stallings; Cryptography and Network Security, Pearson publication, 4th edition, 2004.

3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Pearson Education, 2003.
4. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.

L	T	P	C
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Course Objectives:

- Be able to use the basic features of web browsers, such as Internet Explorer and Firefox;
- Be able to use such Internet tools as email, ftp, and search engines;
- Understand the implications of Internet on society, primarily in the aspects of communication, commerce, crime, ethics, and privacy;
- Understand the generic principles of computer programming as applied to implementing basic web-based applications;
- Use the knowledge both of algorithmic functions and of computer programming in web-based application settings;

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Apply client web technologies.

CO2: Design and implement website using XHTML and CSS.

CO3: Apply JavaScript to provide better website user experience.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S	M					M		
CO2	S	S	S	S	S					M		
CO3	M	S	S	S	S					M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT – I	12
Introduction: Introduction to Internet, History of Internet, Internet Standards, Practical uses of Internet. Component of the Internet: Connection requirements and options, Internet addressing, Internet standards, Web browser basics.	
UNIT – II	12
Building Blocks: Understanding protocols, Transmission Control Protocol/Internet Protocol, Name resolution protocols, Client-side protocols, Internet client infrastructure.	
UNIT –III	12
Components of web page: HTML, DHTML, CSS, JavaScript, XML; Website Design, Overview of Web Servers , Core Components: Hardware platforms, Internet server components, Web servers, E-mail servers, FTP servers, Proxy servers, News servers, Directory servers, Mirrored servers.	
UNIT – IV	12
Networking Hardware and Software Components: Network Interface Cards, Network Cables, Network Connecting Devices etc.	
UNIT – V	12
How Web Applications Work, Web Objects, Building a Simple internet Program- case study.	

TOTAL HOURS: 60

TEXT BOOKS:

1. Douglas E Comer ,”Computer Networks and Internets With Internet Applications”, Pearson , 2008.
2. B.Forouzan ,”Data Communication and Networking “,McGraw Hill,2007.
3. William Stallings ,”Computer Network with Internet Protocols”,Pearson ,2003.

REFERENCES:

1. Deitel And Deitel ,”Internet & World wide Web :How to Program”,Pearson,2012.
2. Danny Goodman ,”Dynamic HTML: The Definitive Reference (2nd Edition)”,O’reilly, 2008.
3. Bryan Pfaffenberger, Bill Karrow,” HTML 4 Bible”, Wiley,2000.
4. Stuart Conway ,” HTML 4.01 Programmer’s Reference”, Wrox Press 2001.

L	T	P	C
3	1	0	4

MCS155 BIO-INSPIRED ARTIFICIAL INTELLIGENCE

Course Objectives:

- To appreciate the use of biological aspects in building intelligent systems
- To understand the algorithms, programming and applications of Evolutionary and genetic algorithms and neural and fuzzy systems
- To appreciate the adaptation of cellular and developmental systems
- To focus on the understanding of artificial immune systems and its applications
- To understand issues in developing collective and behavioural systems.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Use existing open source tools to build an application using genetic approaches

CO2: Identify different applications suitable for different types of neural networks giving justifications

CO3: Critically analyze the use of cellular systems

CO4: Differentiate the different models of immune systems

CO5: Do a literature survey on applications of artificial immune systems

CO6: Implement the Particle swarm and Ant colony algorithms within a framework and build applications

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S						M		
CO2	S	S		S						M		
CO3	S	S	M	S						M		
CO4	S	S	M	S						M		
CO5	S	S	M	S						M		
CO6	S	S		S						M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. Seminar 4. Online Test 5. End Semester Exam	Course End Survey

UNIT -I 12**EVOLUTIONARY SYSTEMS**

Evolutionary Systems – Artificial Evolution - Genetic Representations - Evolutionary Measures - Types of Evolutionary Algorithms - Schema Theory. Evolutionary Computation- Representation- Selection- Reproduction. Genetic Algorithms - Canonical Genetic Algorithm – Crossover- Mutation - Control Parameters – Applications. Genetic Programming - Tree-Based Representation – Building Block Genetic Programming –Applications. Evolutionary Programming – Basics –Operators –Strategy Parameters -Evolutionary Programming Implementations

UNIT- II 12**NEURAL AND FUZZY SYSTEMS**

Neural Networks - Biological Nervous Systems - Artificial Neural Learning - Architecture. Unsupervised Learning - Self-Organizing Feature Maps. Supervised Learning – Types- Learning Rules. Radial Basis Function Networks. Reinforcement Learning – Model Free - Neural Networks and Reinforcement Learning. Fuzzy Systems- Fuzzy Sets – Logic and Reasoning – Controllers- Rough Sets.

UNIT -III 12**CELLULAR AND DEVELOPMENT SYSTEMS**

Cellular Systems - The Basic Ingredients - Cellular Automata -Modelling - Classic Cellular Automata – Other Cellular Systems – Computation - Artificial Life - Complex Systems - Analysis and Synthesis of Cellular Systems. Developmental Systems - Potential Advantages of a Developmental Representation -Rewriting Systems - Synthesis of Developmental Systems - Evolution and Development – Defining Evolutionary Developmental Systems - Evolutionary Rewriting Systems –Developmental Programs and Processes

UNIT- IV 12**IMMUNE SYSTEMS AND COLLECTIVE SYSTEMS**

Natural Immune systems - Classical View -Working -Constituents of Biological Immune Systems - Immunity Types - Learning the Antigen Structure - The Network Theory - The Danger Theory –Artificial Immune Systems - Algorithms - Classical View Models - Clonal Selection Theory Models – Network Theory Models - Danger Theory Models - Applications and Other AIS models Applications- Biological Self-Organization - Particle Swarm

Optimization - Basics - Social Network Structures – Variations - Basic PSO Parameters - Optimization - Applications. Ant Colony Optimization – Cemetery Organization and Brood Care - Division of Labor –Application.

UNITV

12

BEHAVIORAL SYSTEMS

Behavioral Systems - Behavior in Cognitive Science - Behavior in Artificial Intelligence – Behavioral Systems – Behavior Based Robots –Evolution - Co-evolution - Learning and Self Reproduction of Behavioral Systems. Cultural Algorithms - Culture and Artificial Culture - Cultural Algorithm – Belief Space – Fuzzy Cultural Algorithms – Applications. Co-evolution – Types - Competitive and Cooperative Co-evolution.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Claudio Mattiussi, Dario Floreano "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies" (Intelligent Robotics and Autonomous Agents series), MIT Press, 2008.

REFERENCES:

1. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition , Wiley; 2007.
2. Russell C. Eberhart, Yuhui Shi "Computational Intelligence: Concepts to Implementations", Morgan Kaufmann; first edition 2007.

M.TECH – INFORMATION TECHNOLOGY
FULL TIME
I - IV SEMESTERS

SEMESTER-I							
SL.NO	SUB CODE	Category	SUBJECT NAME	L	T	P	C
Theory							
1	MMA107	PM	Operation Research	4	0	0	4
2	MCS101	PC	Data Structure and Algorithms	4	0	0	4
3	MIT101	PC	Computer Networks & Security	4	0	0	4
4	MCS102	PC	Advanced Computer Architecture	4	0	0	4
5	MIT102	PC	Advances in Database	4	0	0	4
Practical							
6	MIT1L1	PC	Networking Lab	0	0	3	2
7	MIT1L2	PC	Data Structures Lab	0	0	3	2
Total Credits-24							

SEMESTER-II							
SL.NO	SUB CODE	Category	SUBJECT NAME	L	T	P	C
Theory							
1	MIT201	PC	Object Oriented Software Engineering	4	0	0	4
2	MIT202	PC	Web Technology	4	0	0	4
3	MIT203	PC	Data Warehousing and Data Mining	4	0	0	4
4	MIT204	PC	UNIX Internals	4	0	0	4
5	MIT2E1	PE-I	Elective-I	3	0	0	3
Practical							
6	MIT2L1	PC	Web Technology Lab	0	0	3	2
Total Credits-21							

SEMESTER-III							
SL.NO	SUB CODE	Category	SUBJECT NAME	L	T	P	C
Theory							
1	MIT301	PC	Cloud Computing	3	0	0	3
2	MIT3E2	PE-III	Elective-II	3	0	0	3
3	MIT3E3	PE-III	Elective-III	3	0	0	3
3	MIT3E4	OE	Elective-IV	3	0	0	3
Project							
5	MIT3P1	PR	Project Phase-I	0	0	12	6
Total Credits-18							

SEMESTER-IV							
SL.NO	SUB CODE	Category	SUBJECT NAME	L	T	P	C
Project							
1	MIT4P2	PR	Project Phase-II	0	0	24	12

TOTAL NO. OF CREDITS FOR THE PROGRAMME : 75

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics(PM)	4	-	-	-	4	6.06
2	Professional Core (PC)	20	18	3		41	54.67
3	Professional Elective (PE)	-	3	6		9	13.63
4	Open Elective (OE)	-	-	3		3	4.55
5	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	6	12	18	27.28
	Total Credit	24	21	18	12	75	100%
	Total Contact Hour	26	22	24	24	96Hrs	

LIST OF ELECTIVES

SUB.CODE	SUBECT NAME	L	T	P	C
PROFESSIONAL ELECTIVE-I					
MIT001	Network Protocols	3	0	0	3
MIT002	Distributed Computing	3	0	0	3
MIT003	Soft Computing	3	0	0	3
MIT004	Software Project Management	3	0	0	3
PROFESSIONAL ELECTIVE-II					
MIT005	High Speed Networks				
MIT006	Grid Computing	3	0	0	3
MIT007	Fuzzy and Genetic Algorithm	3	0	0	3
MIT008	Software Reliability	3	0	0	3
PROFESSIONAL ELECTIVE-III					
MIT009	Network Administration	3	0	0	3
MIT010	Cloud Computing	3	0	0	3
MIT011	Bio-Inspired Artificial Intelligence	3	0	0	3
MIT012	Software Metrics	3	0	0	3

OPEN ELECTIVE - I					
MST070	Research Methodology	3	0	0	3
MIT013	Virtualization Techniques	3	0	0	3
MBA067	Financial Project Management	3	0	0	3
MBA068	IT Service Management	3	0	0	3

Course Code	Course Name: OPERATIONS RESEARCH	L	T	P	C

MMA107	Total Contact Hours:60				4	0	0	4
	Prerequisite:Engineering Mathematics							
	Course Designed by :Dept of Information Technology							
OBJECTIVES								
• Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively; • Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry; • Skills in the use of Operations Research approaches and computer tools in solving real problems in industry; • Mathematical models for analysis of real problems in Operations Research.								
COURSE OUTCOMES (COs)								
CO1	Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry.							
CO2	Formulate a managerial decision problem into a mathematical model							
CO3	Understand Operations Research models and apply them to real-life problems;							
CO4	Use computer tools to solve a mathematical model for a practical problem.							
CO5	Identify and develop operational research models from the verbal description of the real 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			
	CO2	H	H	M	H			
	CO3	H	H	M	H			
	CO4	H	H		H			
	CO5	H	H	H	H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Poisson Process – Markovian Queues – Single and Multi-server Models – Little’s formula – Machine Interference Model – Steady State analysis – Self Service Queue

UNIT II ADVANCED QUEUEING MODELS 12

Non- Markovian Queues – PollaczekKhintchine Formula – Queues in Series – Open Queueing Networks –Closed Queueing networks.

UNIT III SIMULATION 12

Discrete Even Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queueing systems.

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method Transportation and Assignment Problems.

UNIT VNON-LINEAR PROGRAMMING 12

Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker conditions – Quadratic Programming.

TEXT BOOKS

- 1.Winston.W.L. “Operations Research”, Fourth Edition, Thomson Brooks/Cole, 2003.
- 2.Taha, H.A. “Operations Research: An Introduction”, Ninth Edition, Pearson Education Edition, Asia, New Delhi, 2002.

REFERENCES

- 1.Robertazzi. T.G. “Computer Networks and Systems – Queuing Theory and Performance Evaluation”, Third Edition, Springer, 2002 Reprint.
- 2.Ross. S.M., “Probability Models for Computer Science”, Academic Press, 2002.
- 3.Trivedi.K.S., “Probability and Statistics with Reliability, Queueing and Computer Science Applications”, John Wiley and Sons, 2nd Edition, 2002.
- 4.Hwei Hsu, “Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes”, Tata McGraw Hill Edition, New Delhi, 2004.
- 5.Yates. R.D. and Goodman. D. J., “Probability and Stochastic Processes”, Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.
6. <http://www.faadooengineers.com>

Course Code MCS101	Course Name: DATA STRUCTURE AND ALGORITHMS	L	T	P	C
	Total Contact Hours: 60	4	0	0	4
	Prerequisite:Programming in C and C++				
	Course Designed by :Dept of Information Technology				
OBJECTIVES • To provide knowledge in various data structures and algorithms. • To introduce techniques for analyzing the efficiency of computer algorithms.					

COURSE OUTCOMES (COs)						
CO1	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills					
CO2	Understand the properties of various data structures;					
CO3	Identify the strengths and weaknesses of different data structures;					
CO4	Design and employ appropriate data structures for solving computing problems;					
CO5	Possess the knowledge of various existing 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	M	M	L	
	CO2	H				
	CO3	H	M	M	L	
	CO4	H				
	CO5	H		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – 1 INTRODUCTION

12

Basic concepts of objects oriented programming – Abstract data types – List – Implements –Arrays- Cursors, Pointers

UNIT – 2 BASIC DATA STRUCTURES

12

Stack, Queue- Implementation –Application Tress – Traversal – General – Binary – Expression Search Tree – AVL Trees – Splay Trees – B Trees

UNIT – 3 ADVANCED DATA STRUCTURES

12

Set – Basic Operation – Advanced Set Representation – Priority Queue – Applications – Graphs – Traversals- Representation

UNIT – 4 MEMORY MANAGEMENT

12

Issues – Storage allocation – Dynamic – Compaction, Garbage collection – Buddy Systems.

UNIT – 5 ALGORITHM ANALYSIS AND DESIGN

12

Algorithm Analysis – Sorting- Searching – design Techniques – Divide & Conquer – Greedy – Dynamic programming – Backtracking – Branch And Bound Knapsack – Traveling Salesman Problem – Graph Coloring – Queens Problem

References:

- 1.Aho, Hopcroft , Ullman ,”Data Structure & Algorithm “ , Pearson Education, 2005
- 2.SartajSahni,” Data Structure, Algorithm and Application in C++”, Second Edition, Universities Press.
- 3.Howrowitz, Sahni, Mehta, “Fundamental of Data Structure in C++”, Universities Press.
- 4.M.A Weis , “Data Structure &Algorithm & Algorithm Analysis in C++”, Benjamin Cummings , 112124
- 5.Sara Baase , “ computer Algorithm – Introduction To Design and Analysis “, Pearson Education , 2005
6. <http://lib.mdp.ac.id/ebook/Karya%20Umum/Dsa.pdf>

Course Code MIT101	Course Name: COMPUTER NETWORKS & SECURITY	L	T	P	C	
	Total Contact Hours: 60	4	0	0	4	
	Prerequisite: Computer Networks					
	Course Designed by :Dept of Information Technology					
OBJECTIVES • At the end of the course, the students will be able to: • Build an understanding of the fundamental concepts of computer networking. • Familiarize the student with the basic taxonomy and terminology of the computer networking area. • Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking. • Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.						
COURSE OUTCOMES (COs)						
CO1	Identify some of the factors driving the need for network security.					
CO2	Identify and classify particular examples of attacks.					
CO3	Define the terms vulnerability, threat and attack.					
CO4	Identify physical points of vulnerability in simple networks.					
CO5	Explain the implications of implementing encryption at different levels of the OSI reference model.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	M			M

	CO2	H	H	L	H	M
	CO3	H	H	M	M	M
	CO4	H	H	M	M	
	CO5	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT 1 COMPUTER NETWORKS

12

Introduction: the Uses of Computer Networks – Networks hardware – Network software Reference Models – Example of networks – Network standardization. -The physical layer: The theoretical basis for data communication – Guided Transmission media – Wireless transmission – PSTN – Mobile telephone –Communication satellite. The Data Link layer: Data link layer design issue – Error detection and correction – Elementary data link protocols – Sliding window protocols – Example of data link protocols – ETHERNET – 802.11, 802.16,Bluetooth – data link layer switching

UNIT II COMPUTER LAYERS

12

The Network layer: Network layer design issue- Routing algorithms- Congestion control algorithm- Internetworking – Networks layer in Internet. The Transport layer: Transport layer design issue – Transport protocols- Simple transport protocols – Internet transport protocols UDP, TCP.

UNIT III NETWORK SECURITY

12

The application layer: Domain name system- Electronic mail- World Wide Web – Multimedia – Cryptography, digital signature – Communication security. Attacks – services – Mechanisms- Conventional Encryption – Classical and modern Techniques – Encryption Algorithm – Confidentiality.

UNIT IV ENCRYPTION

12

PUBLIC KEY ENCRYPTION: RSA- Elliptic curve Cryptography – Number Theory Concepts MESSAGE AUTHENTICATION: Hash Functions – Digest Function – Digital Signature – Authentication Protocols,

UNIT V SYSTEM SECURITY

12

SYSTEM SECURITY: Intruders- Viruses –Worms -Firewalls: Design Principles and Types – Trusted System

References:

1. Andrew S. Tanenbaum, "Computer Networks", Pearson Education. 4th edition 2002.
2. William Stallings, "Data and computers communication", 7th Edition, Pearson Education, 2005.
3. Douglas E. Comer, "Internetworking with TCP/IP – Volume", 4th Edition, Pearson Education, 2005.
4. Forouson, "Data and Computer communication", Tata McGraw Hill.
5. William Stallings, "Cryptography & Network Security – Principle & Practice", Fourth Edition, Pearson Education, 2006.
6. <http://antoanthongtin.vn/Portals/0/UploadImages/kiennt2/Sach/Sach-CSDL4/Springer%20-%20Computer%20Network%20Security.pdf>

Course Code MIT102	Course Name: ADVANCED COMPUTER ARCHITECTURE			L	T	P	C
	Total Contact Hours: 60			4	0	0	4
	Prerequisite: Computer Organization and Architecture						
	Course Designed by :Dept of Information Technology						
OBJECTIVES The aim of this module is to emphasize on the concept of a complete system consisting of asynchronous interactions between concurrently executing hardware components and device driver software in order to illustrate the behavior of a computer system as a whole.							
COURSE OUTCOMES (COs)							
CO1		Understand the advanced concepts of computer architecture.					
CO2		Exposing the major differentials of RISC and CISC architectural characteristics.					
CO3		Investigating modern design structures of Pipelined and Multiprocessors systems.					
CO4		Become acquainted with recent computer architectures and I/O devices, as well as the low-level language required to drive/manage these types of advanced hardware.					
CO5		Preparing selected reports that imply some emergent topics supporting material essence.					
Mapping of Course Outcomes with 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	M	H	H	L	
	CO2	H	H	H	M	L	
	CO3	H	M	L	M	L	
	CO4	H	M	M	L	L	
	CO5	H				M	

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

UNIT I PIPELINING AND ILP

12

Fundamentals of Computer Design - Measuring and Reporting Performance - Instruction Level Parallelism and Its Exploitation - Concepts and Challenges - Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction - Speculation - Multiple Issue Processors – Case Studies.

UNIT II ADVANCED TECHNIQUES FOR EXPLOITING ILP

12

Compiler Techniques for Exposing ILP - Limitations on ILP for Realizable Processors - Hardware versus Software Speculation - Multithreading: Using ILP Support to Exploit Thread-level Parallelism - Performance and Efficiency in Advanced Multiple Issue Processors - Case Studies.

UNIT III MULTIPROCESSORS

12

Symmetric and distributed shared memory architectures – Cache coherence issues - Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.

UNIT IV MULTI-CORE ARCHITECTURES

12

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture.- hp architecture.

UNIT V MEMORY HIERARCHY DESIGN

12

Introduction - Optimizations of Cache Performance - Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines - Design of Memory Hierarchies - Case Studies.

REFERENCES

1. John L. Hennessy and David A. Patterson, “Computer Architecture – A quantitative approach”, Morgan Kaufmann / Elsevier, 4th. edition, 2007.
2. David E. Culler, Jaswinder Pal Singh, “Parallel Computing Architecture : A hardware/ software approach”, Morgan Kaufmann / Elsevier, 11297.
3. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Pearson Education, Seventh Edition, 2006.
4. <http://cs.baylor.edu/~maurer/aida/courses/archintro.pdf>

Course Code MIT103	Course Name: ADVANCES IN DATABASE				L	T	P	C
	Total Contact Hours: 60				4	0	0	4
	Prerequisite: Database Management System							
	Course Designed by :Dept of Information Technology							
OBJECTIVES								
This course is devoted to new database technology with emphasis on object orientation. The focus is mainly on the data modeling aspect. Other aspects handled are, e.g., transaction management, active mechanisms, and heterogeneous database management systems. The course provides a picture of existing database systems and concrete perspectives and is intended for the potential user of new database systems.								
COURSE OUTCOMES (COs)								
CO1	Explain and evaluate the fundamental theories and requirements that influence the design of modern database systems							
CO2	Assess and apply database functions and packages suitable for enterprise database development and database management.							
CO3	Critically evaluate alternative designs and architectures for databases and data warehouses							
CO4	Discuss and evaluate methods of storing, managing and interrogating complex data							
CO5	Explain and critically evaluate database solutions for data exchange							
Mapping of Course Outcomes with 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	L				
	CO2	H	M	L	M	L		
	CO3	H	H	L	M	M		
	CO4	H	M	M	M	H		
	CO5	H	M	L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT- I OBJECT AND OBJECT RELATIONAL DATABASE 12

Object Based Databases: Overview, complex Data Types, Structured Types and Inheritance in SL, table Inheritance, Array and Multiset Types in SQL, Object –Identity and Reference Types in SQL, Implementing O-R features, Persistent Programming Languages, ObjectRelational Mapping, Object – Oriented versus Object- Relational.

UNIT-II EMERGING TECHNOLOGIES 12

XML: Motivation, Structure of XML data, XML Document schema, Querying and Transformation, Application Program Interface to XML, Storage of XML data, XML applications.

UNIT-III DATABASE QUERY PROCESSING 12

Query processing: Overview, Measures of Query Cost, Selection operating, sorting, Join Operation, Other Operations, Evaluation of Expressions. Query Optimization: Overview, Transformation of Relational Expressions, Estimating Statistics of Expressing Results, Choice of Evaluation plans, Materialized Views.

UNIT-IV PARALLEL AND DIDTRIBUTED DATABASES 12

Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, IntraqueryParallelism, Interoperation ParallelismQuery Optimization, Design of Parallel Systems. Distributed Databases: Homogenous and Heterogeneous Databases, distributed data storage, Distributed Transactions, Commit Protocols, concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, cloud Based Databases, Directory systems.

UNIT-V ADVANCED DATA MODELS 12

Advanced Application development: Performance Tuning, Performance Benchmarks Other Issues in Application Development, Standardization Spatial and Temporal Data and Mobility:Motivation, Time in Databases, spatial and Geographical |Data, Multimedia Databases, Mobility and Personal databases

REFERENCES

1. Abraham Silbershatz, Henry F Korth, S Sudharshan, “Database System Concepts”, McGrawHill International Edition, Sixth Edition, 2010
2. ElmasriNavathe, Somayajulu, Gupta, “ Fundamentals of Database Systems”, Pearson Education, Fourth Edition, 2006.
3. CJ Date, A Kannan, S Swamynathan, “An Introduction to database Systems”, Pearson Education, Eight Edition, 2006
4. Ramakrishna, Gehrke, “Database Management, “International Edition, Third Edition, 2003
5. <http://aries.ektf.hu/~hz/pdf-tamop/pdf-xx/Radvanyi-hdbms-eng2.pdf>

Course Code MITILI	Course Name: NETWORKING LAB				L	T	P	C
	Total Contact Hours:60				0	0	4	2
	Prerequisite: Computer Networks							
	Course Designed by : Dept of Information Technology							
OBJECTIVES • be able to analyse a communication system by separating out the different functions provided by the network • understand that there are fundamental limits to any communications system; • understand the general principles behind multiplexing, addressing, routing, reliable transmission and other stateful protocols as well as specific examples of each; • understand what FEC is and how CRCs work; • be able to compare communications systems in how they solve similar problems; • have an informed view of both the internal workings of the Internet and of a number of common Internet applications and protocols.								
COURSE OUTCOMES (COs)								
CO1	Understand computer network basics, network architecture, TCP/IP and OSI reference models.							
CO2	Identify and understand various techniques and modes of transmission							
CO3	Describe data link protocols, multi-channel access protocols and IEEE 802 standards for LAN							
CO4	Describe routing and congestion in network layer with routing algorithms and classify IPV4 addressing scheme							
CO5	Discuss the elements and protocols of transport layer							
Mapping of Course Outcomes with 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	M	H	M	M		
	CO2	H		H		M		
	CO3	M	H	M	L	M		
	CO4	H		L		L		
	CO5	M	M		L	L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		

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

LIST OF EXPERIMENTS:

1. Socket Programming
 - a. TCP Sockets
 - b .UDP Sockets
 - c. Applications using Sockets
2. Simulation of Sliding Window Protocol
3. Simulation of routing Protocols
4. Development of application such as DNS/HTTP/E_mail/Muliti_user Chat
5. Simulation of networking management protocols
6. Study of Networking Simulator Packages such as opnet, ns2, etc.

Course Code MIT1L2	Course Name: DATA STRUCTURE LAB				L	T	P	C
	Total Contact Hours:60				0	0	4	2
	Prerequisite: Programming in C and C++							
	Course Designed by : Dept. of Information Technology							
OBJECTIVES								
- To develop skills to design and analyze simple linear and non linear data structures - To Strengthen the ability to identify and apply the suitable data structure for the given real world problem - To Gain knowledge in practical applications of data structures.								
COURSE OUTCOMES (COs)								
CO1	Be able to design and analyze the time and space efficiency of the data structure							
CO2	Be capable to identity the appropriate data structure for given problem							
CO3	Have practical knowledge on the application of data structures							
CO4	An understanding of the basic data structures.							
CO5	The ability to estimate big-O timings.							
Mapping of Course Outcomes with 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	M	H	H	H	L		
	CO2	M	L	H	H			
	CO3	M		M	H	M		
	CO4	H	M	L	M			
	CO5	H	H	L	M	M		

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

LIST OF EXPERIMENTS:

1. Min heap
2. Heaps
3. Leftist heap
4. AVL Tree
6. Tries
7. Quick sort
8. Convex hull
9. 0/1 Knapsack using Dynamic Programming
10. Graph coloring using backtracking

Course Code MIT201	Course Name: OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
	Total Contact Hours:60	4	0	0	4
	Prerequisite: Unified Modeling Language				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES • To learn about software prototyping, analysis and design • To learn UML and its usage • To estimate and scheduling of objects • To implement and test an object.					
COURSE OUTCOMES (COs)					
CO1	Demonstrate the conceptual, practical and technical skills of planning and monitoring a project plan using an appropriate CASE tool				
CO2	Demonstrate an understanding of Agile Development				
CO3	Describe in detail the theory, concepts and methods pertaining to the Unified Modelling Language (UML).				
CO4	Create requirements using use case modelling concepts.				
CO5	Demonstrate conceptual and technical skills in the analysis, design and implementation of a software system using Object Oriented Concepts.				

Mapping of Course Outcomes with 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	M			H
	CO2	H	M	M	H	
	CO3	H	L			L
	CO4	H	L	L		
	CO5	H	H		H	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

12

Software Engineering Paradigms - Software Development process models - Project & Process - Project management – Process & Project metrics - Object Oriented concepts & Principles.

UNIT II PLANNING & SCHEDULING

12

Software prototyping - Software project planning – Scope – Resources - Software Estimation - Empirical Estimation Models-Planning-Risk Management - Software Project Scheduling – Object Oriented Estimation & Scheduling.

UNIT III ANALYSIS & DESIGN

12

Analysis Modeling - Data Modeling - Functional Modeling & Information Flow Behavioral Modeling-Structured Analysis - Object Oriented Analysis - Domain Analysis-Object Oriented Analysis process - Object Relationship Model - Object Behavior Model. Design Concepts & Principles - Design Process - Design Concepts - Modular Design – Design Effective Modularity - Introduction to Software Architecture - Data Design – Transform Mapping – Transaction Mapping – OOD - Design System design process- Object design process - Design Patterns.

UNIT IV IMPLEMENTATION & TESTING

12

Top-Down , Bottom-Up , object oriented product Implementation & Integration. Software

Testing methods-White Box, Basis Path-Control Structure –Black Box, Unit Testing- Integration testing Validation & System testing. Testing OOA & OOD models-Object oriented testing strategies.

UNIT V MAINTENANCE

12

Maintenance process-System documentation-program evolution dynamicsMaintenance costs Maintainability measurement – Case Studies

TEXT BOOKS

- 1.Stephen R Schach, “Classical and Object-Oriented Software Engineering – With UML and C++”, McGraw Hill, New Delhi, 2002.
- 2.Ivar Jacobson, “Object Oriented Software Engineering”, Pearson Education, 1992

REFERENCES

- 1.Roger S.Pressman, Software engineering- A practitioner’s Approach, McGraw-Hill International Edition, Fifth Edition , 2001.
- 2.Ian Sommerville, Software engineering, Pearson education Asia, Sixth edition, 2000.
- 3.PankajJalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.
- 4.James F Peters and WitoldPedrycz, “Software Engineering – An Engineering Approach”, John Wiley and Sons, New Delhi, 2000.
- 5.Ali Behforooz and Frederick J Hudson, “Software Engineering Fundamentals”, Oxford University Press, New Delhi, 1996.
- 6.http://www.uccs.info/ucc/ucc3/ucc_folder/cs3500/books/Prentice%20Object%20Oriented%20Software%20Engineering%20Using%20UML%20Patterns%20and%20Java%203rd%202012.pdf

Course Code MIT202	Course Name: WEB TECHNOLOGY	L	T	P	C
	Total Contact Hours:60	4	0	0	4
	Prerequisite: Scripting Language				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES • To understand the concepts and architecture of the World Wide Web. • To understand and practice mark up languages • To understand and practice embedded dynamic scripting on client side Internet Programming • To understand and practice web development techniques on client-side					
COURSE OUTCOMES (COs)					
CO1	Acquire knowledge about functionalities of world wide web				
CO2	Explore markup languages features and create interactive web pages using them				

CO3		Learn and design Client side validation using scripting languages				
CO4		Acquire knowledge about Open source JavaScript libraries				
CO5		Able to design front end web page and connect to the back end databases				
Mapping of Course Outcomes with 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	M	M	H	M	L
	CO2	M		H		
	CO3	M	M		M	M
	CO4	M		H		
	CO5	M	M	H	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

12

History of the Internet and World Wide Web – HTML 4 protocols –HTTP, SMTP, POP3, MIME, IMAP- Introduction to JAVA Scripts – Object Based Scripting for the web. Structures – Functions –Arrays – Objects.

UNIT II DYNAMIC HTML

12

Introduction – Object refers, Collectors all and Children. Dynamicstyle, Dynamic position, frames, navigator, Event Model – On check– On load – One nor – Mousier – Form process – Event Bubblers –Filters – Transport with the Filter – Creating Images – Addingshadows – Creating Gradients – Creating Motion with Blur – DataBinding – Simple Data Binding – Moving with a record set – Sortingtable data – Binding of an Image and table.

UNIT III MULTIMEDIA

12

Audio and video speech synthesis and recognition – ElectronicCommerce – E-Business Model – E- Marketing – Online Paymentsand Security – Web Servers – HTTP request types – SystemArchitecture – Client Side Scripting and Server side Scripting –Accessing Web servers – IIS – Apache web server.

UNIT IV DATABASE- ASP – XML

12

Database- Relational Database model – Overview, SQL – ASP –Working of ASP – Objects – File System Objects – Session tracking and cookies – ADO – Access a Database from ASP – Server side Active-X Components – Web Resources – XML – Structure in Data – Name spaces – DTD – Vocabularies – DOM methods.

UNIT V SERVLETS AND JSP

12

Introduction – Servlet Overview Architecture – Handling HTTPRequest – Get and post request – redirecting request – multi-tier applications – JSP – Overview – Objects – scripting – Standard Actions – Directives.

TEXT BOOK

1. Deitel & Deitel, Goldberg, Internet and World Wide Web – How to Program, Pearson Education Asia, 2001.

REFERENCES

1. Eric Ladd, Jim O' Donnell, Using HTML 4, XML and JAVA, Prentice Hall of India, QUE, 1999.
2. Aferganatel, Web Programming: Desktop Management, PHI, 2004.
3. Rajkamal, Web Technology, Tata McGraw-Hill, 2001.
4. [https://78d0cafdec1787a7bff1fbca7d10f12af8369dc8.googleusercontent.com/host/0Byp6EJD-1552LXRCaFgxWXpJSHM/KELAS_3KS3/Pemrograman%20Berbasis%20Web/Web%20Technologies%20-%20A%20Computer%20Science%20Perspective%20-%20J.%20Jackson%20\(Pearson,%202007\)%20BBS.pdf](https://78d0cafdec1787a7bff1fbca7d10f12af8369dc8.googleusercontent.com/host/0Byp6EJD-1552LXRCaFgxWXpJSHM/KELAS_3KS3/Pemrograman%20Berbasis%20Web/Web%20Technologies%20-%20A%20Computer%20Science%20Perspective%20-%20J.%20Jackson%20(Pearson,%202007)%20BBS.pdf)

Course Code MIT203	Course Name: DATA WAREHOUSING AND DATA MINING	L	T	P	C
	Total Contact Hours:	4	0	0	4
	Prerequisite: Database Management System				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining. They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply. They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.					
COURSE OUTCOMES (COs)					
CO1	Design and security issues and architectures and network technologies for building, deploying and managing data.				
CO2	warehouses, data mining, data visualisation and decision support computing systems				
CO3	Distributed data management and practice for modern computer systems				

CO4		Advanced modelling techniques for building modern computer systems involving Data Warehouses.				
CO5		Business, industrial and commercial context of building data warehouses and data mining software 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	M			
	CO2	H		H	H	M
	CO3	H	M	L	H	M
	CO4	H		H	H	M
	CO5	H	L	L		L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

12

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II

12

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis– Constraint-Based Association Mining.

UNIT III

12

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification

by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT V

12

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V

12

Mining Object, Spatial, Multimedia, Text and Web Data:Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

REFERENCES

- 1.Jiawei Han and MichelineKamber “Data Mining Concepts and Techniques” Second Edition, Elsevier, Reprinted 2008.
- 2.Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
- 3.K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
- 4.G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
- 5.Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.
- 6.<http://www.essi.upc.edu/~aabello/publications/11.IGIBook1.pdf>

Course Code MIT204	Course Name: UNIX INTERNALS	L	T	P	C
	Total Contact Hours:60	4	0	0	4
	Prerequisite: Operating System				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES To get thorough understanding of the kernel.. To understand the file organization and management. To know the various system calls. To have a knowledge of process architecture, process control & scheduling and memory management.					
COURSE OUTCOMES (COs)					

CO1	Implementation of Unix process management and scheduling.					
CO2	Implementation of a virtual memory system.					
CO3	Implementation of some local and distributed file systems.					
CO4	Implementation of socket based intercrosses communication.					
CO5	Implementation of the internet protocols TCP and IP					
Mapping of Course Outcomes with 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	M	M	H		L
	CO2	M		H	M	
	CO3	M	M	H		L
	CO4	M		M	M	
	CO5	L	H	L		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT IOVERVIEW

12

General Overview of the System: History – System structure – User perspective – Operating system services – Assumptions about hardware. Introduction to the Kernel : Architecture of the UNIX operating system – Introduction to system concepts. The Buffer Cache: Buffer headers – Structure of the buffer pool – Scenarios for retrieval of a buffer– Reading and writing disk blocks – Advantages and disadvantages of the buffer cache.

UNIT IIFILE SUBSYSTEM

12

Internal representation of files: Inodes – Structure of a regular file – Directories – Conversion of a path name to an Inode – Super block – Inode assignment to a new file – Allocation of disk blocks.

UNIT IIISYSTEM CALLS FOR THE FILE SYSTEM

12

Open – Read – Write – File and record locking – Adjusting the position of file I/O – Lseek – Close – File creation – Creation of special files – Changing directory, root, owner, and mode – stat and fstat – Pipes – Dup – Mounting and unmounting file systems – link – unlink.

UNIT IV PROCESSES**12**

Process states and transitions – Layout of system memory – The context of a process – Saving the context of a process – Manipulation of the process address space - Sleep. Process Control: Process creation – Signals – Process termination – Awaiting process termination – Invoking other programs – user id of a process – Changing the size of a process - Shell – System boot and the INIT process– Process Scheduling.

UNIT V MEMORY MANAGEMENT AND I/O**12**

Memory Management Policies : Swapping – Demand paging. The I/O Subsystem : Driver Interface – Disk Drivers – Terminal Drivers– Streams – Inter process communication.

TEXT BOOKS

1. Maurice J. Bach, “The Design of the Unix Operating System”, First Edition, Pearson Education, 1999.

REFERENCES

1. B. Goodheart, J. Cox, “The Magic Garden Explained”, Prentice Hall of India, 1986.
2. S. J. Leffler, M. K. McKusick, M. J. Karels and J. S. Quarterman., “The Design and Implementation of the 4.3 BSD Unix Operating System”, Addison Wesley, 1998.
3. http://www.tutorialspoint.com/unix/unix_tutorial.pdf

Course Code MIT 2L1	Course Name: WEB TECHNOLOGY LAB	L	T	P	C
	Total Contact Hours:45	0	0	4	2
	Prerequisite:Scripting Language				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES • Choose best technologies for solving web client/server problems • Create conforming web pages • Use Javascript for dynamic effects • Use Javascript to validate form input entry • Use appropriate client-side or Server-side applications • Write Perl/CGI scripts • Write PHP scripts • Create adaptive web pages					
COURSE OUTCOMES (COs)					
CO1	Explain the history of the internet and related internet concepts that are vital in understanding web development.				
CO2	Discuss the insights of internet programming and implement complete application over the web.				
CO3	Demonstrate the important HTML tags for designing static pages and separate design from content using.				
CO4	Cascading Style sheet.				
CO5	Utilize the concepts of JavaScript and Java Use web application development software tools i.e.Ajax, PHP and XML etc. and identify the environments currently available				

		on the market to design web sites.				
Mapping of Course Outcomes with 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	M	H	M	M	
	CO2	M	H	M		L
	CO3	M	H	M	M	
	CO4	M	H	L		L
	CO5	L	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS:

- 1.Client Server Scripting Programs
- 2.Simulation of Email and File Transfer Protocols.
- 3.Development of Web Services
- 4.XML and Databases.
- 5.Server Application
- 6.Web Customization.
- 7.Development of E- Business Application

Course Code MIT301	Course Name: CLOUD COMPUTING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks, Distributed Computing				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES - the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges; - the basic ideas and principles in data center design and management; - different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud;					

- about cloud storage technologies and relevant distributed file systems; - the variety of programming models and develop working experience in one of them.						
COURSE OUTCOMES (COs)						
CO1	Explain the core conceptsof the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.					
CO2	Apply the fundamental concepts in datacentersto understand the tradeoffs in power, efficiency and cost.					
CO3	Discuss system virtualizationand outline its role in enabling the cloud computing system model.					
CO4	Illustrate the fundamental concepts of <i>cloud storage</i> and demonstrate their use in storage systems such as Amazon S3 and HDFS.					
CO5	Analyze various cloud programming modelsand apply them to solve problems on the cloud.					
Mapping of Course Outcomes with 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		M		M
	CO2	H	H	M	H	
	CO3	M		H	H	M
	CO4	H	M	L	M	M
	CO5	H		H	M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I 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 Services – Cloud models (IaaS, PaaS, SaaS) – Public vs. Private Cloud – Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

UNIT II VIRTUALIZATION

9

Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O - Devices - Virtual Clusters and Resource management – Virtualization for Data-center - Automation.

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 – MapReduce, Twister and Iterative Map Reduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

UNIT V SECURITY IN THE CLOUD

9

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security overnance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

REFERENCES:

- 1.Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. Kumar Saurabh, “Cloud Computing – insights into New-Era Infrastructure”, Wiley India,2011.
5. [http://cs.ecust.edu.cn/~yhq/course_files/cloud/Cloud Computing Bible.pdf](http://cs.ecust.edu.cn/~yhq/course_files/cloud/Cloud%20Computing%20Bible.pdf)

Course Code MIT001	Course Name: NETWORK PROTOCOLS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks				
	Course Designed by : Dept. of Information Technology				

OBJECTIVES						
This module introduces students to computer networks and concentrates on building a firm foundation for understanding Data Communications and Computer Networks. It is based around the OSI Reference Model which deals with the major issues in the bottom four (Physical, Data Link, Network and Transport) layers of the model. Students are also introduced to the areas of Network Security and Mobile Communications. This module provides the student with fundamental knowledge of the various aspects of computer networking and enables students to appreciate recent developments in the area.						
COURSE OUTCOMES (COs)						
CO1	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;					
CO2	Have a basic knowledge of the use of cryptography and network security;					
CO3	Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;					
CO4	Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure.					
CO5	Have a working knowledge of datagram and internet socket 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
2	CO1	M	H	M	L	
	CO2	M	H	L	M	M
	CO3	M	H	M	M	M
	CO4	H	M	L		
	CO5	H	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I BASIC PROTOCOLS

9

Window based protocols, HDLC-family_SDL, LLC, LAPD, 802.X, protocol family 802.3, 8032.5 Compensation of data link protocols, Network Layer Protocol x.25 protocols, routing protocols, SPX and IPX protocols

UNIT-II INTERNET PROTOCOLS

9

IP-addressing schemes, address resolution protocol, IP_datagram and headers details, IP-routing schemes, route discovery protocol, SLIP and PPP protocols, Internet Control Message Protocol(ICMP),IP version 6,mobile IP

UNIT-III TRANSMISSION CONTROL PROTOCOLS

9

TCP protocol-option TCP and UDP,TCP segment structure-Interpretation of headers, window based flow and congestion control using TCP, socket abstraction, Berkeley socket and Winsock, Winsock programming,

UNIT-IV APPLICATION PROTOCOLS

9

Simple mail transfer protocol, FTP and TFTP, Remote Procedure call, Telnet, Network File system, Worldwide web, servers and browsers, Introduction to web design

UNIT-V NETWORK MANAGEMENT

9

General structure, information extraction and collection instruments, line monitors data scopes, network monitor, communication monitor. Security monitor.Configuration management,change management,fault management,security management,accuracy management,Network capacity planning fundamentals

REFERENCES

1. U.Black,TCP/IP and Related protocols,McGraw Hill,1995
2. Terplan,communication network managements,PHI,1992
3. D.E Corner,internetworking with TCP/IP_VOL1.Phd,3rd edition,1998
4. Udupa,network management system essentials,McGraw Hill,1995
5. <http://bkarak.wizhut.com/www/lectures/networks-07/NetworkProtocolsHandbook.pdf>

Course Code MIT002	Course Name: DISTRIBUTED COMPUTING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Fundamentals of Computing and Programming, Interfacing, Programming, Computer Networks.				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES • The differences among: concurrent, networked, distributed, and mobile. • Resource allocation and deadlock detection and avoidance techniques. • Distributed Transaction Processing system Cryptography and Domain Name system.					
COURSE OUTCOMES (COs)					
CO1	Explain the distributed environment				
CO2	Explain the functionalities of file management system.				
CO3	Organize processes in distributed systems.				

CO4		Demonstrate the access of remote objects for the service.				
CO5		Explain the Concept of Domain Name Distributed Locks.				
Mapping of Course Outcomes with 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	M	H	M	L	
	CO2	M	H	L	M	M
	CO3	M	H	M	M	M
	CO4	H	M	L		
	CO5	H	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT- I INTRODUCTION

9

Characterization of Distributed Systems – Examples – Resource Sharing and the Web – Challenges – System Models – Architectural and Fundamental Models – Networking and Internetworking – Types of Networks – Network Principles – Internet Protocols – Case Studies.

UNIT –II PROCESSES AND DISTRIBUTED OBJECTS

9

Inter-process Communication – The API for the Internet Protocols – External Data Representation and Marshalling – Client –Server Communication – Group Communication – Case Study – Distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications – Java RMI – Case Study.

UNIT- III OPERATING SYSTEM ISSUES

9

The OS Layer – Protection – Processes and Threads – Communication and Invocation – OS Architecture – Security – Overview – Cryptographic Algorithms – Digital Signatures – Cryptography Pragmatics – Case Studies – Distributed File Systems – File Service Architecture – Sun Network File System – The Andrew File System.

UNIT- IV DOMAIN NAME SYSTEM AND LOCKS

9

Name Services – Domain Name System – Directory and Discovery Services – Global Name Service – X.500 Directory Service – Clocks – Events and Process States – Synchronizing Physical Clocks – Logical Time And Logical Clocks – Global States – Distributed Debugging – Distributed Mutual Exclusion – Elections – Multicast Communication Related Problems.

UNIT –V DISTRIBUTED TRANSACTION PROCESSING

9

Transactions – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering – Comparison – Flat and Nested Distributed Transactions – Atomic Commit Protocols – Concurrency Control in Distributed Transactions – Distributed Deadlocks – Transaction Recovery – Overview of Replication And Distributed Multimedia Systems.

TEXT BOOKS

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, 3rd Edition, Pearson Education, 2002.
2. Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems, “Principles and Paradigms”, Pearson Education, 2002.

REFERENCES

1. Sape Mullender, “Distributed Systems”, 2nd Edition, Addison Wesley, 1993.
2. Albert Fleishman, Distributed Systems, “Software Design and Implementation”, Springer, Verlag, 1994.
3. M. L. Liu, “Distributed Computing Principles and Applications”, Pearson Education, 2004.
4. Mughesh Singh, Niranjana, G Shivaratri, “Advanced Concepts in Operating Systems”, Tata McGraw Hill Edition, 2001.
5. [http://read.pudn.com/downloads119/ebook/506473/Distributed%20Computing%20Principles,%20Algorithms,%20and%20Systems%20-%20\[Cambridge%20University%20Press\].pdf](http://read.pudn.com/downloads119/ebook/506473/Distributed%20Computing%20Principles,%20Algorithms,%20and%20Systems%20-%20[Cambridge%20University%20Press].pdf)

Course Code MIT003	Course Name: SOFT COMPUTING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks, Fuzzy Logic, Neural Networks				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES					
1.Soft computing refers to principle components like fuzzy logic, neural networks and genetic algorithm, which have their roots in Artificial Intelligence.					
2. Healthy integration of all these techniques has resulted in extending the capabilities of the Technologies to more effective and efficient problem solving methodologies.					
COURSE OUTCOMES (COs)					
CO1	Identify and describe soft computing techniques and their roles in building intelligent machines.				
CO2	Recognize the feasibility of applying a soft computing methodology for a particular problem				
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems				

CO4		Apply genetic algorithms to combinatorial optimization problems				
CO5		Apply neural networks to pattern classification and regression 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
2	CO1	M	H	H	M	L
	CO2	M	H	H	M	
	CO3	H	H	H	M	L
	CO4	H	H	H	M	
	CO5	H	M	M	L	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 INTRODUCTION TO SOFT COMPUTING ANF NEURAL NETWORKS

9

Evaluation of Computing- Soft computing constituents- From conventional AI to Computational intelligence- machine learning basics

UNIT-2 GENETIC ALGORITHMS

9

Introduction to Genetic Algorithms (GA)-Applications of GA Machine learning- Machine learning approach to knowledge acquisition

UNIT-3 NEURAL NETWORKS

9

Machine learning using Neural Networks- Adaptive Networks- Feed Forward networks- supervised learning neural networks- radial basis function networks- Reinforcement learning- Unsupervised learning neural networks- adaptive Resonance architecture- advance in neural networks

UNIT-4 FUZZY LOGIC

9

Fuzzy sets- Operations on fuzzy sets- Fuzzy relations- membership functions- Fuzzy rules and Fuzzy reasoning- Fuzzy interface systems- Fuzzy expert systems- Fuzzy decision making

UNIT-5 NEURO-FUZZY MODELING

9

Adaptive Neuro-Fuzzy Interface systems- coactive Neuro-Fuzzy Modeling- Classification and regression trees- Data Clustering algorithms- Rulebase Structure identification- Neuro-fuzzy Control- case studies

TEXT BOOKS:

- 1.Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, 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
- 3.James A Freeman and David M Skupura, Neural Network Algorithms, Applications and programming techniques, Pearson Education Press, 2003

REFERENCES:

- 1.Michel Melanie, An introduction to genetic Algorithmn, Prentice Hall, 1998
- 2.David E Goldberg, Genetic Algorithmns in search, optimization and machine learning, Addison Wesley, 1997
- 3.S, N Sivanandam, S. Sumathi and S N Deepa, Introduction To Fuzzy Logic using MATLAB, Springer, 2007
- 4.S, N Sivanandam, and S N Deepa , Introduction To Genetic Algorithmns, Springer, 2007
- 5.Jacek M Zurada, Introduction to artificial Neural Systems, PWS Publishers, 1992
- 6.<http://www2.cs.uh.edu/~ceick/6367/Soft-Computing.pdf>

Course Code MIT004	Course Name: SOFTWARE PROJECT MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES • Deliver successful software projects that support organization's strategic goals • Match organizational needs to the most effective software development model • Plan and manage projects at each stage of the software development life cycle (SDLC) • Create project plans that address real-world management challenges • Develop the skills for tracking and controlling software deliverables					
COURSE OUTCOMES (COs)					
CO1	After completing the course Software Project Management a student is expected to be a				
CO2	to participate in a software development project as a project manager,				
CO3	take responsibility of a project team and project organization,				
CO4	apply theoretical knowledge on project management and software development into practice,				

CO5	be well aware on ethical issues related to software project management and can apply this ethical knowledge in practical situations,					
Mapping of Course Outcomes with 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	M	H		H	H
	CO2	M		M		H
	CO3	H	M		M	M
	CO4	M		M		M
	CO5	H	M		M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I

9

Introduction to software project management- software project versus other types of project-problems-management control- stake holders- requirement specification- information and control in organization .Introduction to stepwise project planning- select –Identity scope and objective-identity project infrastructure- analyses project characteristics = product and activities-estimate effort for each activity- identify activity risk- allocate resource- review/publicize plan- exam plan and lower level of planning- Project evaluation- introduction strategic assessments technical assessments- cost benefits analysis- cash flow forecasting- cost benefit evaluation technique- risk evaluation

UNIT-II

9

Selection of an appropriate project approach- choosing technologies- technical plan and content list- choice of process models- structured models- rapid application development- waterfall model-V-process model- spiral model- software prototyping- ways of categorizing prototypes-tools-Incremental delivery- selecting process model Software effort estimation introduction- Where problems with over and under estimates- basis for software estimating- software effort estimation techniques- expert judgement- Albrecht function point analysis- function points marks 2- object points procedural code oriented approach-COCOMO

Activity planning- objectives- project schedule- project and activities- sequencing and scheduling activities- network planning models- formulating a network model- using dummy activities- Representing lagged activities- adding time dimension- forward pass- backward pass- identifying the critical path- activity float- shortening project duration- identifying critical activities- precedence networks

UNIT-III

9

Risk management- nature of risk management- Identification- analysis- reducing evaluation Z values =Resource allocation- nature of resource- requirements- scheduling critical paths- counting the cost- Resource schedule- cost schedule- scheduling sequence-Monitoring and control crating the frame work- collecting the data- visualizing the progress cost monitoring- earned value- prioritizing monitoring- change control

UNIT-IV

9

Managing contracts- types of contracts- stages contract placements- terms of the contract management acceptance- managing people and organizing teams- organizational behavior background- selecting the right person for the job- instruction in the best methods-motivation decision making- leadership- organizational structures. Software quality- importance- defining- ISO9126- practical measures- product versus process quality management- external standards- techniques to help enhance software quality.

UNIT-V

9

Small projects- some problems- content of a project plan PRINCE 2- An overview- BS6079 1996 an overview- euro method- an overview”

TEXT BOOKS

- 1.Bob Hugles and Mikecoterrel- Software management 2nd edition-McGraw Hill
- 2.Walker Royce- Software project management- Addison Wesley
- 3.http://ceit.aut.ac.ir/~sa_hashemi/My%20Teachings/BS-CEIT-IT%20Project%20Management/Books&Resources/Software%20Project%20Management.pdf

Course Code MIT005	Course Name: HIGH SPEED NETWORKS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES					
To facilitate the students on the basis of ATM and Frame relay concepts and explain the various types of LAN's and to know about their applications.					
COURSE OUTCOMES (COs)					
CO1	List techniques used to achieve 100 and 1000 Mb/s in Ethernet				
CO2	Understand each field in IPv4 and IPv6				
CO3	Appreciate the challenges in design of Wireless Sensor Networks				

CO4	Suggest modification for protocols in Ad Hoc networks					
CO5	Categorize layers in ATM protocol					
Mapping of Course Outcomes with 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	
	CO2	H	H	M	H	
	CO3	H	M	H	M	
	CO4	H	M	H	H	
	CO5	H	H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I HIGH SPEED LANS

9

Fast Ethernet technology, FDDI, SONET and SDH standards. Performance of HIGH SPEED LAN Throughput, delay and reliability, Wavelength division multiplexed LAN-Routing and switching in WDM networks, Giga bit LAN

UNIT-II BISDN AND FAST PACKET SWITCHING

9

Overview of ISDN-User interface, architecture and limitation of narrow band ISDN (N-ISDN) and evolution of broad band ISDN (B-ISDN), Fast packet switching architecture- Batchier Banyan architectures and their performance analysis

UNIT-III ASYNCHRONOUS TRANSFER MODE NETWORKS

9

ATM protocol architecture. ATM adaptation layer, packet switching techniques VP/VC encapsulation. TM cells header interception, Source characteristics and source modeling.

UNIT-IV ATM TRAFFIC MANAGEMENT

9

Traffic management issue in ATM-Resource management, connection management policing, and reactive control principles. Fundamentals of Asynchronous multiplexing Markov modulated processes discrete time traffic modeling and queue analysis, application to CAC, leaky bucket and ECN/ICN.

UNIT-V ATM SIGNALLING AND DATA COMMUNICATION OVER ATM**9**

ATM signaling fundamentals.TCP/IP over ATM-challenges and proposals.LAN emulator over ATM.Performance of Data communication over ATM

REFERENCES:

- 1.Craig partridge,gigabitnetworking,Addison Wesley,1997.
- 2.Stallings W,ISDN-BISDN with frame relay and ATM, P.H International,1995
- 3.R.Onvural,Asynchronous Transfer Mode Network_PerformanceIssue,Artech House,1995.
- 4.W.Stallings,High Speed Networks,TCP/IP and design principles,PHI,1998
- 5.<http://thebooksout.com/download/high%20speed%20networks%20and%20internet%20by%20william%20stallings%20free%20ebook.pdf>

Course Code MIT006	Course Name: GRID COMPUTING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Computer Networks, Cloud Computing							
	Course Designed by : Dept. of Information Technology							
OBJECTIVES To understand the genesis of grid computing - To know the application of grid computing - To understanding the technology and tool kits to facilitated the grid computing								
COURSE OUTCOMES (COs)								
CO1	be able to evaluate enabling technologies such as high-speed links and storage area networks for building computer grids;							
CO2	be able to utilise grid computing and clustering middleware, such as Parallel Virtual Machine (PVM), Message Passing Interface (MPI), HPC Portals, and Peer-to-Peer networks for implementing virtual super computing resources;							
CO3	be able to design a grid computing application in one of the key application areas e.g. Computer Animation, E-Research;							
CO4	be able to install a grid computing environment;							
CO5	develop communications skills and accept the code of professional conduct and practice through short presentations and group work.							
Mapping of Course Outcomes with 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	M	H		M		
	CO2	H	M	M	M			
	CO3	H	L	M				
	CO4	H	M	L				

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

UNIT-I INTRODUCTION TO GRID COMPUTING

7

Introduction- the grid- Past, Present, and Future- Application of grid computing organizations and their roles

UNIT-II GRID COMPUTING ARCHITECTURE

8

Grid computing anatomy- Next generation grid computing initiatives- merging the Grid services architecture with Web services architecture

UNIT-III GRID COMPUTING TECHNOLOGIES

11

OGSA- sample use case that drives the OGSA platform components- OGSA and WSRF- OGSA Basic services- security standards for grid computing

UNIT-IV GRID COMPUTING TOOL KIT

10

Globus Toolkit- Versions- Architecture- GT Programming model- A sample grid services implementation

UNIT-V HIGH LEVEL GRID SERVICES

9

High level grid services- OGSA.NET middleware solution mobile OGS.NET for grid computing on mobile devices

TEXT BOOKS:

1.Joshy Joseph & Craig Fellenstein, Grid Computing, Pearson/PHI PTR-2003

REFERENCES:

1.Fran Bernam, Geoffrey Fox, Anthony J G Hey, Grid Computing: Making the Global infrastructure a reality, John Wiley and sons , 2003

2.Ahman Abbas, Grid Computing : A Practical Guide to Technology and Applications, Charles River media, 2003

3.<https://www.redbooks.ibm.com/redbooks/pdfs/sg246778.pdf>

Course Code MIT007	Course Name: FUZZY AND GENETIC ALGORITHM	L	T	P	C

		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Engineering Mathematics						
		Course Designed by : Dept. of Information Technology						
OBJECTIVES								
- To introduce the ideas of Neural Networks, fuzzy logic and use of heuristics based on human experience. - To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.								
COURSE OUTCOMES (COs)								
CO1		Learn the unified and exact mathematical basis as well as the general						
CO2		Principles of various soft computing techniques.						
CO3		Provide detailed theoretical and practical aspects of intelligent						
CO4		Modeling, optimization and control of non-linear systems.						
CO5		Prepare the students for developing intelligent systems through case						
Mapping of Course Outcomes with 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	M	H		M		
	CO2	H	M	M	M			
	CO3	H	L	M				
	CO4	H	M	L				
	CO5	H	M	M	L	L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I INTRODUCTION:

9

Uncertainty and Imprecision-Statistics and Random process - Uncertainty in information - Fuzzy sets and Membership - Chance versus ambiguity, classical Sets and Fuzzy Sets : Classical Sets - Fuzzy sets - Sets as points in hypercube, Classical Relations and Fuzzy Relations Cartesian product -Crisp Relations - Fuzzy Relations - Tolerance and Equivalence Relations - Value Assignments.

UNIT-I I FUZZY MEMBERSHIP FUNCTION**9**

Membership Functions: Features of Membership function - Standard forms and boundaries – Fuzzification - Membership value assignments. -Fuzzy to Crisp conversions: Lambda cuts for fuzzy sets - Lambda cuts for fuzzy relations- Defuzzification Methods.

UNIT-III FUZZY ARITHMETICS**9**

Fuzzy Arithmetic, Numbers, Vectors and the Extension Principle: Extension Principle- Fuzzy numbers - Internal analysis in arithmetic - Approximate methods of extension. Classical logic and fuzzy logic: Classical predicate logic - Fuzzy logic - Approximate reasoning - Fuzzy Tautologies - Other forms of the implication & composition operation.

UNIT-IV FUZZY NATURAL LANGUAGE**9**

Fuzzy Rule Based Systems: Natural language - Linguistic hedges - Rule based systems - Graphical techniques of inference, Fuzzy Nonlinear Simulation: Fuzzy Relational Equations - Partitioning - Nonlinear Simulation using fuzzy rule based systems - FAMs. Fuzzy decision making.

UNIT-V FUZZY CLASSIFICATION**9**

Fuzzy Classification: Classification by equivalence relations- Cluster analysis - Cluster validity - Classification metric - Hardening the fuzzy - Partition, Fuzzy Pattern Recognition : Feature analysis-Partitions of the feature space - Single sample identification - Image processing syntactic recognition.

TEXT BOOKS

1. S. Rajasekaran and G.A.V.Pai, ,”Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2011.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Edition 2009.

REFERENCE

1. J. Harris,”An Introduction to Fuzzy Logic Applications”, Springer, 2001

Course Code MIT008	Course Name: SOFTWARE RELIABILITY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Probability				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES To provide knowledge in • Design principles for creating safe and reliable systems • Reliability modeling • Current trends in software reliability					
COURSE OUTCOMES (COs)					
CO1	Understand common principles of software and system reliability engineering and				

		also system safety.				
CO2	Learn about software reliability measures.					
CO3	Study software test methodology.					
CO4	Learn about modeling software reliability growth.					
CO5	Analyze the reliability of multi-component 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	M	H		M
	CO2	H	M	M	M	
	CO3	H	L	M		
	CO4	H	M	L		
	CO5	H	M	M	L	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT –I INTRODUCTION TO RELIABILITY ENGINEERING

9

Reliability - Repairable and Non Repairable systems - Maintainability and Availability - Designing for higher reliability - Redundancy - MTBF - MTTF MDT - MTTR- k out of n systems

UNIT -II SOFTWARE RELIABILITY

9

Software reliability - Software reliability Vs Hardware reliability - Failures and Faults - Classification of Failures - Counting - System Configuration - Components and Operational Models - Concurrent Systems - Sequential Systems - Standby Redundant systems

UNIT –III SOFTWARE RELIABILITY APPROACHES

9

Fault Avoidance - Passive Fault detection - Active Fault Detection - Fault Tolerance - Fault Recovery - Fault Treatment

UNIT- IV SOFTWARE RELIABILITY MODELING

9

Introduction to Software Reliability Modeling - Parameter Determination and Estimation - Model Selection - Markovian Models - Finite and Infinite failure category Models - Comparison of Models - Calendar Time Modeling

UNIT –V SPECIAL TOPICS IN SOFTWARE RELIABILITY

9

Management Techniques for reliability - Organization and Staffing - Programming Languages and Reliability - Computer Architecture and Reliability - Proving Program correctness & Reliability Design - Reliability Testing - Reliability Economics

TEXT BOOKS

1. John D. Musa, "Software Reliability", McGraw Hill, 2004.
2. Patric D. T.O Connor, "Practical Reliability Engineering", 4th Edition, John Wesley & sons, 2003.

REFERENCES

1. DoronPeled, "Software Reliability Methods", Springer,2011.
2. Alessandro Birolini, "Reliability Engineering", Springer ,2010.

Course Code MIT009	Course Name: NETWORK ADMINISTRATION	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite: Computer Networks					
	Course Designed by : Dept. of Information Technology					
OBJECTIVES This addresses key technology management issues as they are applied to information resourcerces management (IRM) for information centers and information services. It also inclu fundamentals of networking and telecommunications covering LAN's to "informa Superhighways." It covers techniques for management of communication resources and services information to oversee the network administration and network system management.						
COURSE OUTCOMES (COs)						
CO1	A basic understanding of management information system terminology.					
CO2	The components and the operations, managerial, and strategic roles of information systems within an organization.					
CO3	The major concepts, development, and managerial implications involved in computer hardware, software, database management, and telecommunications technologies.					
CO4	How information technology is used in modern information systems to support end-user applications, enterprise operations, e-Commerce, and managerial decision making.					
CO5	The development of information systems solutions for business problems and how to implement 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

2	CO1	M	H	M		H
	CO2	M	H	M	M	H
	CO3	L	H	H	M	M
	CO4	M	M	L		L
	CO5	L	M	M	L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I OPERATION PROCEDURES

9

Function of a system administrator hardware and software configuration of the system-Auto configuration of devices, General operational guidelines running diagnostic Programs procedures for system control power down single/multi-user mode, Modify device configuration, recovery from system trouble reconfiguring the OS

UNIT-II USER SERVICES

9

Login administration-Addind/Removing users-Setting up user environment and user communication procedure for user services

UNIT-III IDENTIFICATION AND SECURITY

9

System security-special administration-password, user id, group id-Formatting and partitioning disks, bad block handling-Disk, management procedures.

UNIT-IV FILE SYSTEM ADMINISTRATION

9

File system Organization-Super block-Free block-Mounting and unmounting file system checking in a file system, Back up and restore procedures-Try management-Spooler administration-System accounting procedures-Day to day operations-Setting up accounting system, recovery from failure-Daily reports.

UNIT-V

9

Hardware management-Basic Networking Procedures-Performance Management-Finding problems and fittinproblems improvingperformance-Performance-tools like sar, saf-System reconfiguration procedures.

REFERENCE:

- 1.SCO open server-Graphics environment Administration Guide,SCO Inc-1993
- 2.Super stack land Hun Management,User Guid,3 COM,1996
- 3,Acces Builder 2000,Installation giud,3COM,1996
- 4.Acces builder Remote Client user giud,1996
- 5.<https://eketab2.files.wordpress.com/2007/09/addisonwesleythepracticeofsystemandnetworkadministration2ndeditionjul2007.pdf>

Course Code MIT011	Course Name: BIO-INSPIRED ARTIFICIAL INTELLIGENCE				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Bio Inspired Computing							
	Course Designed by : Dept. of Bio Informatics							
OBJECTIVES								
• To appreciate the use of biological aspects in building intelligent systems • To understand the algorithms, programming and applications of Evolutionary and genetic algorithms and neural and fuzzy systems • To appreciate the adaptation of cellular and developmental systems • To focus on the understanding of artificial immune systems and its applications • To understand issues in developing collective and behavioural systems.								
COURSE OUTCOMES (COs)								
CO1		Use existing open source tools to build an application using genetic approaches						
CO2		Identify different applications suitable for different types of neural networks giving justifications						
CO3		Critically analyze the use of cellular systems						
CO4		Differentiate the different models of immune systems						
CO5		Do a literature survey on applications of artificial immune 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		M		M		
	CO2	H	H	M	H			
	CO3	M		H	H	M		
	CO4	H	M	L	M	M		
	CO5	H		H	M			

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

UNIT –I EVOLUTIONARY SYSTEMS

9

Evolutionary Systems – Artificial Evolution - Genetic Representations - Evolutionary Measures - Types of Evolutionary Algorithms - Schema Theory. Evolutionary Computation- Representation- Selection- Reproduction. Genetic Algorithms - Canonical Genetic Algorithm – Crossover- Mutation - Control Parameters – Applications. Genetic Programming - Tree-Based Representation – Building Block Genetic Programming –Applications. Evolutionary Programming – Basics –Operators –Strategy Parameters -Evolutionary Programming Implementations

UNIT- II NEURAL AND FUZZY SYSTEMS

9

Neural Networks - Biological Nervous Systems - Artificial Neural Learning - Architecture.Unsupervised Learning - Self-Organizing Feature Maps. Supervised Learning – Types- Learning Rules. Radial Basis Function Networks. Reinforcement Learning – Model Free - Neural Networks and Reinforcement Learning. Fuzzy Systems- Fuzzy Sets – Logic and Reasoning – Controllers- Rough Sets.

UNIT -III CELLULAR AND DEVELOPMENT SYSTEMS

9

Cellular Systems - The Basic Ingredients - Cellular Automata -Modelling - Classic Cellular Automata – Other Cellular Systems – Computation - Artificial Life - Complex Systems - Analysis and Synthesis of Cellular Systems. Developmental Systems - Potential Advantages of a Developmental Representation -Rewriting Systems - Synthesis of Developmental Systems - Evolution and Development – Defining Evolutionary Developmental Systems -Evolutionary Rewriting Systems –Developmental Programs and Processes

UNIT- IV IMMUNE SYSTEMS AND COLLECTIVE SYSTEMS

9

Natural Immune systems - Classical View -Working -Constituents of Biological Immune Systems - Immunity Types - Learning the Antigen Structure - The Network Theory - The Danger Theory –Artificial Immune Systems - Algorithms - Classical View Models - Clonal Selection Theory Models – Network Theory Models - Danger Theory Models - Applications and Other AIS models Applications- Biological Self-Organization - Particle Swarm Optimization - Basics - Social Network Structures – Variations - Basic PSO Parameters - Optimization - Applications.

Ant Colony Optimization – Cemetery Organization and Brood Care - Division of Labor – Application.

UNITV BEHAVIORAL SYSTEMS 9

Behavioral Systems - Behavior in Cognitive Science - Behavior in Artificial Intelligence – Behavioral Systems – Behavior Based Robots –Evolution - Co-evolution - Learning and Self Reproduction of Behavioral Systems. Cultural Algorithms - Culture and Artificial Culture - Cultural Algorithm – Belief Space – Fuzzy Cultural Algorithms – Applications. Co-evolution – Types - Competitive and Cooperative Co-evolution.

TEXT BOOKS:

1. Claudio Mattiussi, Dario Floreano "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies" (Intelligent Robotics and Autonomous Agents series), MIT Press, 2008.

REFERENCES:

1. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition , Wiley; 2007.
2. Russell C. Eberhart, Yuhui Shi "Computational Intelligence: Concepts to Implementations", Morgan Kaufmann; first edition 2007.

Course Code MIT012	Course Name: SOFTWARE METRICES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Software Engineering				
	Course Designed by : Dept. of Information Technology				
OBJECTIVES 1.knowledge of how software metrics can be used for controlling, managing and predicting the software development processes 2.a framework for software metrics activities 3.an understanding of the value of a scientific approach to software measurement 4.an awareness of problems related to applying software measurement 5. experiences in setting up metrics and models.					
COURSE OUTCOMES (COs)					
CO1	present and discuss the fundamentals of software measurement				
CO2	professionally present, argue, discuss how software measures can be used during the software processes and be able to professionally apply them				
CO3	discuss the state-of-the-art in software measurement process models and CMMI's measurement requirements				
CO4	professionally present, argue, discuss the issues related to applying software measurement and how to set up measures and models				
CO5	Focus on the results of student learning, not on the learning process or on teaching				
Mapping of Course Outcomes with 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	M	M	H		
	CO2	M		H	M	M
	CO3	M	H	H		L
	CO4	M		H	M	L
	CO5	M	H	M		L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT- IMEASUREMENTS THEORY

9

Fundamentals of Measurement- Measurements in software engineering- scope of software matrices- measurements theory- goal based framework- software measurement validation

UNIT-II DATA COLLECTION AND ANALYSIS

9

Empirical Investigation- planning experiments- software metrics data collection- analysis methods- statistical methods

UNIT-III PRODUCTS METRICES

9

Measurements of internet product attributes- size and structure- external product attributes- measurements of quality

UNIT-IV QUALITY METRICES

9

Software quality metrics- product quality- Process quality- Metrics for software Maintenance- case studies of metrics program- Motorola- Hp and IBM

UNIT-V MANAGEMENT MATRICS

9

Quality management models- Rayeigh Model- Problem tracking report (PTR) model- Reliability Growth model- Model Evaluation- Orthogonal classification

REFERENCES:

1. Norman E- Fentar, Share Lawrence Pfler, Software Metrics, International Thomson Computer Press, 1997
2. Stephen H Kin, Metric and Model in Software Quality Engineering, Addison Wesley, 1993
3. <http://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/centre-for-bio-inspired-technology/7291000.PDF>

Course Code	Course Name: RESEARCH METHODOLOGY				L	T	P	C
MST070	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Professional Courses							
	Course Designed by :Department of civil							
OBJECTIVESTo know the various types of Formulation of Research Task,modeling and simulation, analysis of reports and report writing.								
COURSE OUTCOMES (COs)								
CO1	To understand the basic concept of Formulation of Research Task.							
CO2	To have knowledge about mathematical modeling and simulation							
CO3	To understand experimental modeling.							
CO4	To know about of analysis of report.							
CO5	To know about of concept of report writing.							
Mapping of Course Outcomes with 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	M	M					
	CO2	H	M		L			
	CO3	H	M					
	CO4	M	M		L	L		
	CO5	M	M	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I RESEARCH CONCEPTS**9**

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT-II MATHEMATICAL MODELING AND SIMULATION**9**

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT-III EXPERIMENTAL MODELING**9**

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT-IV ANALYSIS OF RESULTS**9**

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT-V REPORT WRITING**9**

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TEXT BOOKS

1. Willkenson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata McGraw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, „Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovsky, „Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

Course Code MIT013	Course Name: VIRTUALIZATION TECHNIQUES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks, Distributed Computing				

		Course Designed by : Dept. of Information Technology				
OBJECTIVES						
• Introduce Virtualization and Cloud Computing concepts and technologies • Provide information on networked storage for virtualization infrastructure needs • Provide hands-on laboratory exercises on storage and virtualization						
COURSE OUTCOMES (COs)						
CO1	Outline the fundamental concepts and techniques of layer 2 switching including Virtual LANs (VLANS).					
CO2	Configure, verify, and troubleshoot VLANs.					
CO3	Configure and deploy Advanced IP services such as NAT, PAT and DHCP.					
CO4	Implement and configure network, access, and resource monitoring and data protection tasks in a virtualised environment.					
CO5	Discuss the benefits and requirements for achieving scalability and high availability in data centrevirtualisation 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	M	H	M		
	CO2	M	M	L	L	L
	CO3	M	M	M	M	
	CO4	H	H	M		L
	CO5	M	M	L	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I OVERVIEW OF VIRTUALIZATION

9

Basics of Virtualization – Types of Virtualization Techniques – Merits and demerits of Virtualization – Full Vs Para-virtualization – Virtual Machine Monitor/Hypervisor - Virtual Machine Basics – Taxonomy of Virtual machines – Process Vs System Virtual Machines – Emulation: Interpretation and Binary Translation - HLL Virtual Machines

UNIT II SERVER AND NETWORK VIRTUALIZATION

9

Server Virtualization: Virtual Hardware Overview - Server Consolidation – Partitioning Techniques -Uses of Virtual server Consolidation – Server Virtualization Platforms, Network Virtualization: Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization - Routing Protocols

UNIT III STORAGE, DESKTOP AND APPLICATION VIRTUALIZATION

9

Storage Virtualization: Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level, Desktop Virtualization: Concepts - Desktop Management Issues - Potential Desktop Virtualization Scenarios - Desktop Virtualization Infrastructures,

UNIT IV APPLYING VIRTUALIZATION

9

Practical Virtualization Solutions: Comparison of Virtualization Technologies: Guest OS/ Host OS – Hypervisor – Emulation – Kernel Level – Shared Kernel, Enterprise Solutions: VMWare Server – VMWare ESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box, Server Virtualization: Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS

UNIT V CLOUD COMPUTING

9

Cloud Computing Basics - Cloud Computing Definition – Evolution of Cloud Computing - General Cloud Environments – Cloud Services – Service Providers – Google – Amazon – Microsoft – IBM – EMC –NetApp - Salesforce – Tools for building private cloud - Open Issues in Cloud Computing – Cloud security challenges, Cloud Programming: Hadoop - MapReduce – HDFS – Hadoop I/O – Developing a MapReduce Application

REFERENCES:

1. Danielle Ruest, Nelson Ruest - Virtualization: A Beginner's Guide, TMH, 2009
2. James E. Smith, Ravi Nair, - Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.
3. David Marshall, Wade A. Reynolds, - Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.
4. Kumar Reddy, Victor Moreno, - Network virtualization, Cisco Press, July, 2006.
5. Chris Wolf, Erick M. Halter, - Virtualization: From the Desktop to the Enterprise, APress 2005.
6. <https://131c0c0518c8b955a6aeebc8f060a9a209a36ce1.googledrive.com/host/0BxFbv-5Vt8ikb0RMVkp3V0N3dHc/Virtualization-Techniques-Systems-Multimedia-Applications-3319057405.pdf>

Course Code MBA067	Course Name: FINANCIAL PROJECT MANAGEMENT				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Software Project Management							
	Course Designed by : Dept. of Management							
OBJECTIVES								
• Present financial management as an analytical process. • Understand ratio analysis and the importance of EVA and FCF's. • Introduce risk and rates of return in decision-making. • Understand the time value of money. • Learn to calculate the cost of funds to an organization. • Introduce and understand the capital budgeting process. • Learn to forecast the amount of funds a firm requires to operate.								
COURSE OUTCOMES (COs)								
CO1	Ethical & Professional Judgment							
CO2	Information Literacy and Computer Skills							
CO3	Creative and Critical Thinking							
CO4	Field Specific Knowledge and Experience							
CO5	Creation of Value							
Mapping of Course Outcomes with 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	M	M	L	H	L		
	CO2	M	M	M	M			
	CO3	L	L	M	M	L		
	CO4	M	M	L	M			
	CO5	L	M	M	L	L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I COST AND CAPITAL MANAGEMENT

9

Values- Cost and capital Investment Foundations- Fundamentals of Value Driven Software Engineering- Identifying and Assessing Customer Valued Features

UNIT II CONCURRENT DEVELOPMENT

9

Understanding Software Architecture Economics, Specifying Value Maximizing Chronology, Incorporating Concurrent Development Strategies ,

UNIT III VALUE DRIVEN SOFTWARE ENGINEERING

9

Managing & Accounting For Intangibles, Enhancing the Unified Process, Fundamentals Of Value Driven Software Engineering, Identifying &Assessing Customer Valued Features, Understanding Software Architecture Economics,

UNIT IV UNIFIED PROCESS

9

Specifying Value Maximizing Chronology, Incorporating Concurrent Development Strategies, Managing & Accounting For Intangibles, Enhancing the Unified Process.

UNIT V CASE STUDY

9

CA 1 Case Study Assignment Presentation, Crafting The Business Case(Dave), CA2 M.Tech Project Assignment Presentation, Value, Cost &Capital Investment Foundations,

Reference Books :

- 1.Software Engineering as a Business
- 2.Value Based software Engineering
- 3.Value Based Software Engineering: Reinventing “Earned Value Monitoring & Control”
- 4.Business Driven Product Planning Using Feature Vector and Increments
- 5.Making Architecture Design Decisions: An Economic Approach.
- 6.<http://www.free-management-ebooks.com/dldebk-pdf/fme-project-principles.pdf>

Course Code MBA068	Course Name: IT SERVICE MANAGEMENT	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Financial Management				
	Course Designed by : Dept. of Management				
OBJECTIVES • To understand the meaning of project management • To understand the difference between operations and projects • To understand the importance of project management as it effects strategy and business success • To be aware of past performance on projects • To be familiar with project management history					

To be familiar with the planning and execution phases of a project						
COURSE OUTCOMES (COs)						
CO1	A deep preparation in the disciplines necessary for developing solid managerial strategies					
CO2	Quantitative methods and techniques for assessing competition and market dynamics, for developing effective strategies (in terms of cost and value) and measuring their outcomes.					
CO3	capability to identify critical aspects and solve problems in international operations					
CO4	A critical approach to the most recent service management issues and tools					
CO5	Ability to work in team and to assess practical business 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	M	M	M	H	M
	CO2	M	M	M	M	H
	CO3	M	H	L	H	M
	CO4	L	H	M	L	H
	CO5	H	L	M	H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT 1 INFORMATION SYSTEMS

9

Information systems components - Organizations and management -The information system as a sociotechnical system -The strategic use of Information Technology -management information systems -Informational needs of organizations -Capabilities of information systems from an organizational perspective -Information requirements for management -Levels of planning and control with MIS - MIS support for business functions -Management reporting systems and transaction processing systems

UNIT II SYSTEMS AND MANAGEMENT CONCEPTS

9

Systems approach, organizational design, MIS in organizational control -Management theory and management functions -Concepts of planning -Role of information systems in the planning - Using MIS to enhance management control: performance reports, break-even analysis, calculation of financial ratios- managerial decision making -Decision-making -Components of Decision Support Systems -Types of DSS-Building a DSS -Executive Information Systems - Organizational aspects of DSS and EIS

UNIT III CULTURAL DIMENSION OF INFORMATION SYSTEMS DEVELOPMENT 9

Factors of organizational complexity in relation to information systems development -Human aspects of information systems - Contribution of system development approaches (such as Soft Systems Methodology -Measures of performance to cover performance factors and service level agreements - Departmental and project budgets, including specific reference to training costs

UNIT IV PRINCIPLES OF PROFESSIONALISM 9

Professional concepts in relation to professional practices- Business ethics. acquisition of software, hardware, media and consumables -Specification of hardware and software configurations and systems - Implications of throughput, resilience and reliability -Alternatives, costs and solutions -Selection criteria, acquisitions, purchase, hire or lease, facilities management -installation and site planning, security and external threats -Planning, scheduling and co-ordinating contractors, suppliers and services -Progress control and monitoring -Installation, test planning, acceptance criteria and trials-Implications of throughput, resilience and reliability - Workload -External threats and strategies to limit their effect
Security

UNIT V APPLICATIONS AND SYSTEM REQUIREMENTS 9

Distributed, intelligent systems, electronic mail -Communication Networks -Intelligent office - Characteristics of telecommunication systems -Software production -Control of data - Operating system facilities

References:

- 1.McNurlin& Sprague, Information Systems Management in Practice, Prentice Hall (7thEd), 2005, ISBN: 0131968777
- 2.Fidler C. &Rogerson S., Strategic Management Support Systems, Financial Times Management, 1996, ISBN: 0273614185
3. Bott M. F., Professional Issues in Information Technology, The British Computer Society, 2005, ISBN: 1902505654 and 9781902505657
- 4.Holt, J and Newton, J., A Manager's Guide to IT Law, BCS, 2004, ISBN: 1902505557 and 9781902505558
- 5.BS ISO/IEC 17799 Information Technology, Security Techniques: Code of Practice for Information Security Management, British Standards Institute, ISBN: 0580462625
6. <http://www.bcs.org/upload/pdf/itsm-guide-foundation.pdf>

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH. APPLIED ELECTRONICS
(FULL TIME)
I – IV SEMESTERS

SEMESTER-I						
Sub Code	Category	Subject Name	L	T	P	C
Theory						
MMA101	PM	Applied Mathematics for Electronics Engineers	3	2	0	4
MAE101	PC	Statistical Signal Processing	3	0	0	3
MAE102	PC	Advanced Digital System Design	3	0	0	3
MVD102	PC	Introduction to VLSI Design	3	0	0	3
MAE1E1	PE	Professional Elective-I	3	0	0	3
Practical						
MAE1L1	PC	Advanced Electronics system Design Lab-I	0	0	4	2
Total No. of Contact Hours: 21			Total Credits:18			
SEMESTER-II						
Sub Code	Category	Subject Name	L	T	P	C
Theory						
MAE201	PC	Analysis and Design of Analog Integrated circuits	3	0	0	3
MAE202	PC	Computer Architecture and Parallel Processing	3	0	0	3
MAE203	PC	Digital Image Processing	3	0	0	3
MAE2E2	PE	Professional Elective-II	3	0	0	3
MAE2E3	PE	Professional Elective-III	3	0	0	3
Practical						
MAE2L2	PC	Advanced Electronics system Design lab-	0	0	4	2

		II				
Total No. of Contact Hours: 21			Total Credits: 17			

SEMESTER-III						
Sub Code	Category	Subject Name	L	T	P	C
Theory						
MAE3E4	PE	Professional Elective-IV	3	0	0	3
MAE3E5	PE	Professional Elective-V	3	0	0	3
MAE3E6	OE	Open Elective - I	3	0	0	3
MAE3P1	PR	Project work phase-I	0	0	12	6
Total No. of Contact Hours: 22			Total Credits:15			

SEMESTER-IV						
Sub Code	Category	Subject Name	L	T	P	C
MAE4P2	PR	Project work phase-II	0	0	24	12
Total No. of Contact Hours: 24			Total Credits: 12			

OVERALL CREDIT OF THE PROGRAMME – 62

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – I (PE-I)

Code No.	Course Title	L	T	P	C
MAE001	Design and Analysis of Algorithms	3	0	0	3
MAE002	Robotics	3	0	0	3
MAE003	RF System design	3	0	0	3

PROFESSIONAL ELECTIVE – II (PE-II)

Code No.	Course Title	L	T	P	C

MAE005	Advanced Microprocessors and Microcontrollers	3	0	0	3
MAE006	High Speed Switching Architectures	3	0	0	3
MAE 013	Blue Tooth Technology	3	0	0	3

PROFESSIONAL ELECTIVE – III (PE-III)

Code No.	Course Title	L	T	P	C
MAE101	Advanced Digital Signal Processing	3	0	0	3
MAE004	Electromagnetic Interference and Compatibility in System Design	3	0	0	3
MVL010	Optimization Techniques In VLSI Design	3	0	0	3

PROFESSIONAL ELECTIVE – IV (PE-IV)

Code No.	Course Title	L	T	P	C
MAE 015	High Performance communication networks	3	0	0	3
MAE 014	Internet Working Multimedia	3	0	0	3
MAE 011	VLSI SIGNAL PROCESSING	3	0	0	3

PROFESSIONAL ELECTIVE – V (PE-V)

Code No.	Course Title	L	T	P	C
MAE004	DSP Integrated systems	3	0	0	3
MAE 009	Low power VLSI Design	3	0	0	3
MAE 010	Analog VLSI Design	3	0	0	3

OPEN ELECTIVE – I(OE-I)

Code No.	Course Title	L	T	P	C
MED102	EMBEDDED SYSTEMS	3	0	0	3
MED201	ASIC DESIGN	3	0	0	3
	Research Methodology	3	0	0	3

**SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT
HOUR DISTRIBUTION**

S. No.	Sub Area	Credit AS per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics (PM)	4				4	6.06
2	Professional Core (PC)	12	12			24	36.36
3	Professional Electives (PE)	3	6	6		15	22.72
4	Open Electives (OE)			3		3	4.54
5	Project Work, Seminar, Internship, Term Paper, etc. (PR)			6	12	20	30.30
6	Total Credit	18	17	15	12	62	100
7	Total Contact Hour	21	21	22	24	88 Hrs	-

Course Code MMA101	Course Name: APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS				L	T	P	C
	Total Contact Hours:60				3	1	0	4
	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.								
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.							
Mapping of Course Outcomes with 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						
	CO2		M					
	CO3	H						
	CO4			M				
	CO5				L			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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.

REFERENCE 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 Code MAE103	Course Name: STATISTICAL 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: To Introduce the basics of random signal processing and Concept wise Introduction to Estimation and prediction theory.					
COURSE OUTCOMES (COs)					

CO1	Students will analyze the random signal processing					
CO2	Students will learn to understand the speech signal processing					
CO3	Students will develop knowledge in Estimation and Prediction theory.					
CO4	To know about adaptive filtering and its Applications.					
CO5	A brief overview of the processing of speech signals.					
Mapping of Course Outcomes with 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				
	CO2		M			
	CO3			H		L
	CO4	H			M	
	CO5		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION TO RANDOM SIGNAL PROCESSING

9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION

9

Estimation of spectra from finite duration signals, Nonparametric methods - Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric method, AR (p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION

9

Linear Prediction of Signals-Forward and Backward Predictions, Solution to Prony's normal equation, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters. Linear Minimum Mean-Square Error (LMMSE)

UNIT IV ADAPTIVE FILTERS

9

FIR adaptive filters – adaptive filter based on steepest descent method- Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

UNIT V APPLICATION

OVERVIEW-SPEECH

PROCESSING

9

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Short-term Fourier transform (STFT): overview of Fourier representation, non-stationary signals, development of STFT, transform and filter-bank views of STFT; Short time Homomorphic Filtering of Speech; Linear Prediction (LP) analysis: Basis and development, Levinson-Durbin's method, normalized error, LPC spectrum.

TEXT BOOKS:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002.
2. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition",

REFERENCE BOOKS:

1. Pearson Education, 2003.
2. Dimitris G. Manolakis and Vinay K .Ingle , "Applied Digital Signal Processing", Cambridge University Press, 2011.
3. L.R. Rabiner and R.W. Schafer, "Introduction to Digital Speech Processing" (Foundations and Trends in Signal Processing), Now Publishers Inc., USA, 2007.

Course Code MAE102	Course Name: ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C	
	Total Contact Hours: 60	3	1	0	4	
	Prerequisite: Digital communication					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES						
To learn the concepts of theorems and other techniques to design minimized logic functions and To Understand the concepts of synchronous and asynchronous sequential circuit design and						
COURSE OUTCOMES (COs)						
CO1	Ability to analyze and design sequential digital circuits					
CO2	Ability to understand the requirements and specifications of the system required for a given application					
CO3	Ability to understand programmable logic devices					
CO4	To learn about the faults in logic circuits and metods of diagnosing it					
CO5	To learn about programmable logic 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

2	CO1		M			
	CO2	H				
	CO3	H				
	CO4		M			
	CO5			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I ADVANCED TOPICS IN BOOLEAN ALGEBRA

9

Shannon's expansion theorem, Consensus theorem, Octal designation, Run measure, INHIBIT/INCLUSION/AOI/Driver /Buffer gates ,Gate expander, Reed Muller expansion, Synthesis of multiple output combinational logic circuits by product map method ,Design of static hazard free and dynamic hazard free logic circuits.

UNIT II SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

9

Analysis of clocked synchronous sequential Networks (CSSN), Modeling of CSSN, State table assignment and reduction, Design of CSSN, Design of iterative circuit, ASM Chart, ASM Realization. Design of Arithmetic circuits for Fast adder, Array Multiplier.

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

9

Analysis of Asynchronous Sequential Circuit (ASC) ,Flow Table Reduction , Races in ASC , State Assignment Problem and the Transition Table, Design of ASC ,Data Synchronizers, Designing vending Machine Controller, Mixed Operating Mode Asynchronous Circuits.

UNIT IV FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

9

Fault Table Method ,Path Sensitization Method, Boolean Difference Method, Kohavi Algorithm, Tolerance Techniques , The Compact Algorithm, Practical PLA's, Fault in PLA Circuit Test Approach, Transition Check Approach , State identification and fault detection experiment .

UNIT-V PROGRAMMABLE LOGIC DEVICES

9

Basic concepts, Programming technologies, Programmable Logic element(PLE), Programmable Logic Array(PLA), System Design using PLD's-Design of

combinational and sequential circuits using PLD's(CPLD).Programming PAL device using PALSAM ,Design of state machine using Algorithmic State Machines (ASM) chart as a design tool, Introduction to Field Programmable Gate Arrays –Types of FPGA, Xilinx XC 3000 series, Logic Cell Array (LCA),Configurable Logic Blocks(CLB) INPUT/OUTPUT Block(IPB)-Programmable Interconnect Point (PIP),Introduction to Actel AACT2 FAMILY AND XILINX XC 4000 families ,Design examples.

TEXT BOOK:

1. William I.Fletcher, “An Engineering Approach to Digital Design”, PrenticeHall of India.
2. Switching and Finite Automata Theory – Z. Kohavi , 2nd Ed., 2001, TMH
3. Digital Design – Morris Mano, M.D.Ciletti, 4th Edition, PHI.
4. Digital Circuits and Logic Design – Samuel C. Lee , PHI

REFERENCES BOOK:

1. Donald G. Givone, “Digital principles and Design”, Tata McGraw Hill 2002.
2. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003.
3. John M Yarbrough, “Digital Logic applications and Design”, Thomson Learning, 2001.
4. Nripendra N Biswas, “Logic Design Theory”, Prentice Hall of India, 2001.
5. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.

Course Code MVL102	Course Name: INTRODUCTION TO VLSI DESIGN	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					
OBJECTIVES						
To understand the concepts of MOS transistors operations and their AC , DC Characteristics and To know the fabrication process of CMOS technology and its layout design rules and To know the concepts of power estimation and delay calculations in cmos circuits						
COURSE OUTCOMES (COs)						
CO1	To learn the basic MOS and CMOS circuit, characteristics and performance.					
CO2	To learn the circuit components at physical level design.					
CO3	To learn the different abstract levels in Verilog for modeling digital circuits.					
CO4	To learn about the VLSI circuit components and physical design					
CO5	To study the concepts of Verilog in designing digital logic 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
2	CO1		H			
	CO2	L				
	CO3			L		
	CO4		M			

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

UNIT – I MOS TECHNOLOGY AND CIRCUITS

9

MOS Technology and VLSI, Process parameters and consideration for BJT, MOS and CMOS, CMOS logic, MOS transistor theory, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage, Body effect, Design equations, Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model

UNIT –II CMOS CIRCUITS DESIGN PROCESS

9

CMOS fabrication, P -Well process, N -Well process, twin - tub process, MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS logic structures, Transmission gates, Static CMOS design, dynamic CMOS design.

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION

9

Resistance estimation, Capacitance estimation, Inductance, switching characteristics, transistor sizing, power dissipation and design margining. Charge sharing .Scaling.

UNIT – IV VLSI SYSTEM COMPONENTS CIRCUITS AND SYSTEM LEVEL PHYSICAL DESIGN

9

Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits, Ripple carry adders, Carry look ahead adders, High-speed adders, Multipliers. Physical design – Delay modelling, cross talk, floor planning, power distribution, Clock distribution.

UNIT V SPECIFICATION USING VERILOG HDL

9

Basic concepts- identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow and RTL, structural gate level switch level modeling, Design hierarchies, Behavioral and RTL modeling, Test benches, Design of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop

TEXT BOOK:

1. Douglas A. Pucknell and Kamran Eshraghian, “Basic VLSI Design Systems and Circuits”, Prentice Hall of India Pvt. Ltd., 1993.

2. Wayne Wolf, "Modern VLSI Design", 2nd Edition, Prentice Hall 1998.
3. Amar Mukherjee, "Introduction to NMOS and CMOS VLSI System Design," Prentice Hall,

REFERENCES BOOK:

1. John P.Uyemura "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc.,2002..
2. Fabricious E. "Introduction to VLSI Design", McGraw Hill, 1990.
3. J.Bhasker: Verilog HDL primer, BS publication,2001
4. Ciletti Advanced Digital Design with the Verilog HDL, Prentice Hall of India, 2003

Course Code MAE1L1	Course Name: ADVANCED ELECTRONICS SYSTEM DESIGN LAB-1	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						
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 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 description languages					
CO5	To learn about the design of digital circuits of JK, D, T, SR FLIPFLOPS					
Mapping of Course Outcomes with 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			
	CO2	M			L	
	CO3			H		
	CO4		H			L
	CO5	M			M	

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

(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 SUBTRACTOR/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 (HARTLEY OSCILATOR /COLPITTS OSCILATOR AND RC-COUPLED AMPLIFIER)
8. SCHEMATIC CAPTURE & PCB LAYOUT DESIGN USING EDA TOOLS LIKE ORCAD

Course Code MAE201	Course Name: ANALYSIS AND DESIGN OF 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 analyse high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers					
COURSE OUTCOMES (COs)					
CO1	Ability to analyse 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.				
Mapping of Course Outcomes with 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			
	CO2		M			
	CO3	H			M	
	CO4		M			L
	CO5			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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. Kenneth R.Laker, Willy M.C.Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems", McGraw Hill, 1994.
2. Behzad Razavi, "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, Broderon, “Analog MOS Integrated Circuits”, IEEE Press 1989.

Course Code MAE202	Course Name: ARCHITECTURE AND –PARALLEL PROCESSING				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 types of architectures and the importance of scalable architectures and To study the various memories and optimization of memory.								
COURSE OUTCOMES (COs)								
CO1	At the end of the course, the student will be able to:							
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.							
Mapping of Course Outcomes with 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					
	CO2	H		M				
	CO3		H					
	CO4		M		M			
	CO5		H			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I THEORY OF PARALLELSIM –PART-I

7

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

10

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 weak 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

10

Parallel models, Languages and compilers, Parallel program development and environments, UNIX, MACH and OSF/1 for parallel computers.

TEXT BOOK:

1. Kai Hawang, “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 International 1994.

Course Code MAE203	Course Name: DIGITAL IMAGE PROCESSING		L	T	P	C
	Total Contact Hours: 60		3	1	0	4
	Prerequisite: Digital Signal Processing					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES : To understand techniques for image enhancement and to understand techniques for image segmentation.						
COURSE OUTCOMES (COs)						
CO1	To be able to design and implement image enhancement schemes.					
CO2	To be able to design and implement compression schemes.					
CO3	To be able to design and implement restoration schemes.					
CO4	To be able to design and implement segmentation schemes					
CO5	To understand techniques for image compression					
Mapping of Course Outcomes with 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			M	
	CO2		H			

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

UNIT I IMAGE REPRESENTATION

9

Image representation-Image Basis Functions- Two dimensional DFT- Discrete Cosine Transform-Walsh- Hadamard transform-Wavelet transform- Principal component analysis.

UNIT II IMAGE ENHANCEMENT AND RESTORATION

9

Gray level transformation techniques- Spatial domain techniques - Half toning, Median filtering, contrast stretching, Histogram Equalization- Frequency domain techniques - Weiner filtering-Homomorphic filtering- PSFs for different forms of blur - noise models- color image processing.

UNIT III IMAGE SEGMENTATION

9

Segmentation - Similarity and dissimilarity methods- Thresholding - Edge based and Region based methods- Hough transform- Morphological operations - Clustering methods.

UNIT IV IMAGE COMPRESSION

9

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 SIMULATION

9

Implementation of Image processing algorithms - Image Enhancement - Restoration- Segmentation-Coding techniques- Applications.

TEXT BOOKS:

1. Gonzalez R. C. and Woods R.E., "Digital Image Processing", 3rd Edition, Prentice-Hall, 2008.
2. Jain A.K., "Fundamentals of Digital Image Processing", PHI Learning Private Ltd., 1989.
3. William K. Pratt, "Digital Image Processing", John Wiley, 4th Edition, 2007.

REFERENCES BOOKS:

1. Sonka M, "Image Processing, Analysis and Machine Vision", Vikas Publishing

Home (Thomson) 2001.

2. Schalkoff R.J., "Digital Image Processing & Computer Vision", John Wiley & Sons, 1992.
6. Richard O. Duda, Peter E. Hart and David G. Stork., "Pattern Classification", Wiley, 2001.
3. J.W. Woods, "Multidimensional Signal, Image, Video Processing and Coding",
2nd Edition, Academic Press, 2012.

Course Code MAE2L2	Course Name: ADVANCED ELECTRONICS LAB-II			L	T	P	C
	SYSTEM DESIGN LAB-II						
	LIST OF EXPERIMENTS						
	Total Contact Hours:45			0	0	4	2
Prerequisite: Advanced Electronics System Design Lab-I							
Course Designed by : Dept. of Electronics And Communication Engineering							
OBJECTIVES							
To learn about pic microcontroller.							
COURSE OUTCOMES (COs)							
CO1	Students will learn about the interfacing concepts and implement it by using PIC microcontroller.						
CO2	Students will learn about the interfacing concepts and implement it by using stepper motor interface						
CO3	Students will learn about the traffic light controller interfacing concepts and implement it by using PIC microcontroller						
CO4	Students will learn about the Dac / Dc Motor Speed Controller interfacing concepts and implement it by using PIC microcontroller						
CO5	Students will learn about the Pic To Serial (Rs232) Communication interfacing concepts and implement it by using PIC 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	a	b	c	d	e	
2	CO1						
	CO2	H			H		
	CO3		M				
	CO4			M		M	
	CO5		L		M		

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

(EXPERIMENTS FROM 1 TO 6 SHOULD BE DONE USING PIC MICROCONTROLLER)

1. ADC INTERFACE WITH TEMPERATURE SENSOR
2. STEPPER MOTOR INTERFACE
3. TRAFFIC LIGHT CONTROLLER
4. DAC / DC MOTOR SPEED CONTROLLER
5. PIC TO SERIAL (RS232) COMMUNICATION
6. 5X7 MATRIX LED DISPLAY INTERFACE AND 16X2 CHARACTER LCD INTERFACE
7. DESIGN OF SMPS
8. DESIGN OF INVERTER.

ELECTIVES

Course Code MAE001	Course Name: DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Analysis Of Algorithms				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES • Discusses the algorithmic complexity parameters and the basic algorithmic design techniques. • To discuss the graph algorithms, algorithms for NP Completeness Approximation Algorithms and NP Hard Problems.					
COURSE OUTCOMES (COs)					
CO1	Will be able to apply the suitable algorithm according to the given optimization problem.				

CO2	Ability to modify the algorithms to refine the complexity parameters.					
CO3	To discuss the graph algorithms, algorithms for NP Completeness Approximation Algorithms					
CO4	To discuss the Graph Algorithms					
CO5	To discuss the graph algorithms, algorithms for NP Hard 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
2	CO1	H		M		
	CO2		M			
	CO3		H			L
	CO4	M			H	
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Polynomial and Exponential algorithms, big "oh" and small "oh" notation, exact algorithms and heuristics, direct / indirect / deterministic algorithms, static and dynamic complexity, stepwise refinement.

UNIT II DESIGN TECHNIQUES

9

Subgoals method, working backwards, work tracking, branch and bound algorithms for traveling salesman problem and knapsack problem, hill climbing techniques, divide and conquer method, dynamic programming, greedy methods.

UNIT III SEARCHING AND SORTING

9

Sequential search, binary search, block search, Fibonacci search, bubble sort, bucket sorting, quick sort, heap sort, average case and worst case behavior

UNIT IV GRAPH ALGORITHMS**9**

Minimum spanning, tree, shortest path algorithms, R-connected graphs, Even's and algorithms, max-flow min cut theorem, Steiglitz's link deficit algorithm, Kleitman's.

UNIT V SELECTED TOPICS**9**

NP Completeness Approximation Algorithms, NP Hard Problems, Strassen's Matrix Multiplication Algorithms, Magic Squares, Introduction To Parallel Algorithms and Genetic Algorithms, Monte-Carlo Methods, Amortised Analysis.

TEXT BOOK:

1. E.Horowitz and S.Sahni, "Fundamentals of Computer Algorithms", Galgotia Publications
2. D.E.Goldberg, "Genetic Algorithms: Search Optimization and Machine Learning", Addison Wesley, 1989.

REFERENCES:

1. Sara Baase, "Computer Algorithms : Introduction to Design and Analysis", Addison Wesley, 1988.
2. T.H.Cormen, C.E.Leiserson and R.L.Rivest, "Introduction to Algorithms", McGraw Hill, 1994.

Course Code MAE002	Course Name: ROBOTICS		L	T	P	C
	Total Contact Hours:45		3	0	0	3
	Prerequisite: Embedded systems					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES: To study about robotic vision systems and to study robot organizations.						
COURSE OUTCOMES (COs)						
CO1	To develop knowledge about robot hardware.					
CO2	To develop knowledge about robot control ad applications					
CO3	To study basics of artificial intelligence					
CO4	To study basics of Robotic vision systems					
CO5	To study basics of Robot control and application					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	E
2	CO1			H		

	CO2	H		M		
	CO3					L
	CO4		M			
	CO5			L	M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I ROBOT ORGANIZATION

9

Coordinate transformation, kinematics and inverse kinematics, Trajectory planning and remote manipulation

UNIT-II ROBOT HARDWARE

9

Robot sensors, proximity sensors, Range sensors, visual sensors, Ausitory sensors, Robot manipulators, Manipulator dynamics , Manipulator control, acts, end efforts, Robot grippers.

UNIT III ROBOT AND ARTIFICIAL INTELLIGENCE

9

Principles of AI , Basics of learning, planning movement, Basics of knowledge presentations, Robot programming languages.

UNIT IV ROBOTIC VISION SYSTEMS

9

Principles of edge detection, Determining optical flow and shape, Image presentation, pattern recognition, Model directed scene analysis

UNIT V ROBOT CONTROL AND APPLICATION

9

Robot control using voice and infrared, overview of robot applications, prosthetic devices, Robots in material handing, processing assembly and storage.

Text Books:

1. Koren,"Robotics for Engineers", MC Graw Hill International company, Tokyo, 1995

REFERENCE BOOK:

- 1.Vokopravotic, "Introduction to Robotics", Springer, 1998
2. Rathmill K, "Robot Technology and Application", Springer, 1985

Course Code MAE003	Course Name: RF SYSTEM DESIGN		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Microwave Engineering					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES The CMOS RF Front End (RFE) is a very crucial building block and in all of wireless and many high frequency wire-line systems and the RFE has few important building blocks within including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, PowerAmplifiers, and impedance matching circuits.						
COURSE OUTCOMES (COs)						
CO1	The student after completing this course must be able to translate the top level Wireless					
CO2	Communications system specifications into block level specifications of the RFE.					
CO3	The student should also able to carry out transistor level design of the entire RFE					
CO4	The present course will introduce the principles of operation and design principles associated with these important blocks.					
CO5	The course will also provide and highlight the appropriate digital					
Mapping of Course Outcomes with 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		M			
	CO2	H			H	L
	CO3			M		
	CO4		H			
	CO5		M		L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CMOS PHYSICS, TRANSCIEVER SPECIFICATIONS AND ARCHITECTURES

9

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct upconversion Transmitter, Two step upconversion Transmitter.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS

9

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS

9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations , Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

UNIT IV MIXERS AND OSCILLATORS

9

Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, subsampling mixers, Oscillators describing Functions, Colpitts oscillators Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.

UNIT V PLL AND FREQUENCY SYNTHESIZERS

9

Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

TEXT BOOKS:

1. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge,2004.
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.
3. Jan Crols, Michiel Steyaert, “CMOS Wireless Transceiver Design”, Kluwer Academic.

REFERENCE BOOKS:

1. Publishers, 1997.
2. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001
3. Recorded lectures and notes available at. <http://www.ee.iitm.ac.in/~ani/ee6240/>

Course Code MAE005	Course Name: ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C

		Total Contact Hours:45			3	0	0	3
		Prerequisite: Microprocessors And Microcontrollers						
		Course Designed by : Dept. of Electronics And Communication Engineering						
OBJECTIVES To expose the students to the fundamentals of microprocessor architecture.								
COURSE OUTCOMES (COs)								
CO1	The student will be able to work with suitable microprocessor / microcontroller for a specific real world application.							
CO2	To introduce the advanced features in microprocessors and microcontrollers.							
CO3	To enable the students to understand various microcontroller architectures							
CO4	To Study the Motorola 68hc11 microcontrollers							
CO5	To Study the Pic 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	a	b	c	d	e		
2	CO1	H						
	CO2			H	M			
	CO3		H			M		
	CO4			M				
	CO5		M		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I MICROPROCESSOR ARCHITECTURE

9

Instruction Set – Data formats –Addressing modes – Memory hierarchy –register file – Cache – Virtual memory and paging – Segmentation- pipelining –the instruction pipeline – pipeline hazards – instruction level parallelism – reduced instruction set –

Computer principles – RISC versus CISC.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM

9

CPU Architecture- Bus Operations – Pipelining – Branch predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM

9

Organization of CPU – Bus architecture –Memory management unit - ARM instruction set- Thumb Instruction set- addressing modes – Programming the ARM processor.

UNIT IV MOTOROLA 68HC11 MICROCONTROLLERS

9

Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

UNIT V PIC MICROCONTROLLER

9

CPU Architecture – Instruction set – interrupts- Timers- I²C Interfacing –UART- A/D Converter –PWM and introduction to C-Compilers.

TEXT BOOK:

1. Daniel Tabak , ‘ ‘ Advanced Microprocessors” McGraw Hill.Inc., 1995
2. James L. Antonakos , “ The Pentium Microprocessor ‘ ‘ Pearson Education, 1997.
3. Steve Furber , ‘ ‘ ARM System –On –Chip architecture “Addison Wesley , 2000.
4. Gene .H.Miller .” Micro Computer Engineering ,” Pearson Education , 2003.

REFERENCE BOOKS:

1. John .B.Peatman , “ Design with PIC Microcontroller , Prentice hall, 1997.
2. James L.Antonakos ,” An Introduction to the Intel family of Microprocessors ‘ ‘ Pearson Education 1999.
3. Barry.B.Breg,” The Intel Microprocessors Architecture, Programming and Interfacing“ , PHI,2002.
4. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001. Readings: Web links www.ocw.nit.edu www.arm.com

Course Code MAE006	Course Name: HIGH SPEED SWITCHING ARCHITECTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Architectures				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES: To enable the student to understand the basics of switching technologies and their implementation LANs, ATM networks and IP networks.					
COURSE OUTCOMES (COs)					

CO1	The student would be able to identify suitable switch architectures for a specified networking scenario and demonstrate its blocking performance.					
CO2	The student would be in a position to apply his knowledge of switching technologies, architectures and buffering strategies for designing high speed communication networks and analyze their performance.					
CO3	To enable the student to understand the different switching architectures and queuing strategies and their impact on the blocking performances.					
CO4	To expose the student to the advances in packet switching architectures and IP addressing and switching solutions and approaches.					
CO5	To exploit and integrate the best features of different architectures for high speed switching					
Mapping of Course Outcomes with 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			M		L
	CO2		H		M	
	CO3	M				
	CO4			H		M
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I LAN SWITCHING TECHNOLOGY

9

Switching Concepts, LAN Switching, switch forwarding techniques - cut through and store and forward, Layer 3 switching, Loop Resolution, Switch Flow control, virtual LANs.

UNIT II ATM SWITCHING ARCHITECTURES

9

Blocking networks - basic - and- enhanced banyan networks, sorting networks - merge sorting, re-arrangeable networks - full-and- partial connection networks, non blocking networks -Recursive network construction, comparison of non-blocking network, Switching with deflection routing - shuffle switch, tandem banyan switch.

UNIT III QUEUES IN ATM SWITCHES**9**

Internal Queueing -Input, output and shared queueing, multiple queueing networks – combined Input, output and shared queueing - performance analysis of Queued switches.

UNIT IV PACKET SWITCHING ARCHITECTURES**9**

Architectures of Internet Switches and Routers- Bufferless and buffered Crossbar switches, Multi-stage switching, Optical Packet switching; Switching fabric on a chip; Internally buffered Crossbars.

UNIT V IP SWITCHING**9**

Addressing model, IP Switching types - flow driven and topology driven solutions, IP Over ATM address and next hop resolution, multicasting, Ipv6 over ATM.

TEXT BOOKS:

1. Achille Pattavina, "Switching Theory: Architectures and performance in Broadband ATM networks ", John Wiley & Sons Ltd, New York. 1998
2. Rich Siefert, Jim Edwards, "The All New Switch Book – The Complete Guide to LAN Switching Technology", Wiley Publishing, Inc., Second Edition, 2008.
3. Elhanany M. Hamdi, "High Performance Packet Switching architectures", Springer Publications, 2007.

REFERENCES BOOKS:

1. Christopher Y Metz, "Switching protocols & Architectures", McGraw - Hill Professional Publishing, New York. 1998.
2. Rainer Handel, Manfred N Huber, Stefan Schroder, "ATM Networks - Concepts Protocols, Applications", 3rd Edition, Addison Wesley, New York. 1999.

Course Code	Course Name:	L	T	P	C
MDC002	BLUE TOOTH TECHNOLOGY				
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES					
To Study Basic Concepts of Blue Tooth and to understand the structure of Bluetooth hardware, the software structure.					
COURSE OUTCOMES (COs)					
CO1	To develop Skill in the architecture of a Bluetooth system.				
CO2	To understand the structure of Bluetooth hardware, the software structure.				
CO3	To understand the functionality of a Bluetooth protocol				
CO4	To Understand about Bluetooth module,Link controller and management				

CO5	To Study about Bluetooth profiles and Security 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
2	CO1			H		L
	CO2	M			M	
	CO3		H			
	CO4			M		M
	CO5		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT –I BASIC CONCEPTS

9

Origin, blue tooth sig, protocol stack, security, applications and profiles, management, test and qualification and technology basics, Rf and Ir wireless communication

UNIT-II BLUE TOOTH MODULE

9

Antennas patterns, gain and losses : types of antennas: on chip antennas radio interface: Fh modulation symbol timing, power emission and control , performance parameters, Rf Architecture, Blue R f, based band: blue tooth device address system timing, physical links, packet, structuring types and construction ,channel coding and time base synchronisation

UNIT-III LINK CONTROLLER AND MANAGEMENT

9

Lep, controller states, pico net and scattered operations, master/slave role switching Lc Architectural overview, Lmc<Link set up , quality of service, Lmp version, name represent, test mode

UNIT-IV BLUETOOTH HOST

9

LIC and adaptation protocol L2cap signaling : connection; Bluetooth profiles, version 1.0 , generic profiles, serial and object exchange

UNIT-V SECURITY

9

Encryption and security key generation, security mode and architecture, low power operation and Qos management

TEXT BOOKS:

1. Bluetooth connect without cables Jennifer Bray and C. F. Stuntman pearson education 2001

2. Bluetooth revealed: Brent A. Miller and C. Bisdikian, pearson education 2001

REFERENCES BOOKS:

1. Bluetooth Demystified Nathan J. Miller Tata Mc graw Hill 2001

Course Code MAE101	Course Name: ADVANCED DIGITAL 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						
To introduce the Concepts of silicon realization of ASIC and Cmos devices at deep Level						
To study and apply the deep Submicron concepts to Cmos low power devices						
COURSE OUTCOMES (COs)						
CO1	To learn about random signal processing					
CO2	To know about spectrum and linear estimation.					
CO3	To know about adaptive filters					
CO4	To understand the concepts related to Adaptive Filters					
CO5	To understand the concepts related to multirate digital signal processing					
Mapping of Course Outcomes with 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			
	CO2	M				
	CO3		H			
	CO4			M		
	CO5					H

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

UNIT-1 DISCRETE RANDOM SIGNAL PROCESSING

9

Discrete Random Processes, Expectations, Variance, Co-variance, Scalar product, Energy of Discrete Signals- Parseval's Theorem, Wiener Khintchine Relation- Power Spectral Density- Periodogram- Sample Autocorrelation- Sum Decomposition Theorem, Spectral Factorization Theorem- Discrete Random Signal Processing by Linear Systems- Simulation of White Noise- Low Pass filtering of white noise.

UNIT-II SPECTRUM ESTIMATION

9

Non-Parametric Methods- Correlation Method- Co-Variance Estimator- Performance Analysis of Estimator- Barlett Spectrum Estimation - Welch Estimation- Model Based Approach- AR, MA, ARMA Signal Modeling - Parameter Estimation using Yule-Walker Method.

UNIT-III LINEAR ESTIMATION AND PREDICTION

9

Maximum likelihood criterion- efficiency of estimator- least mean squared error criterion- Wiener filter - Discrete Wiener Hoff Equation- Recursive estimators- Kalman filter- linear prediction, prediction error whitening filter, inverse filter- Levinson recursion, Lattice realization and Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT-IV ADAPTIVE FILTERS

9

FIR adaptive filters- Newton's steepest descent method- adaptive filter based on steepest descent method- Widrow Hoff LMS adaptive algorithm- Adaptive channel equalization- Adaptive echocanceller- Adaptive noise cancellation - RLS adaptive filter- Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS adaptive filter.

UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING

9

Mathematical description of sample rate-interpolation and Decimation- continuous time model direct digital approach- Decimation by an integer factor- interpolation by an integer factor- Single and multistage realization- poly phase realization- Application to Sub band coding- Wavelet transform and filter bank implementation of wavelet expansion of signals.

TEXTBOOKS:

1. Monson.H.Hayes, Statistical Digital Processing and Modelling, John Wiley and Sons. INC, New York. 1996.

REFERENCES BOOK:

1. Sophocles J. Orfanidis, Optimum Signal Processing, McGraw Hill. 1990.
2. John.G.Proakis, Dimitris G. Manofakis. Digital Signal Processing Prentice Hall of India, 1995.

Course Code	Course Name:	ELECTROMATIC	L	T	P	C

MAE004	INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN							
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Testing of VLSI Circuits							
	Course Designed by : Dept. of Electronics And Communication Engineering							
OBJECTIVES								
EMI Environment and EMI Coupling Principles and EMI Specification, Standards and Limits and EMI Measurements and Control Techniques and EMC Design of PCBs.								
COURSE OUTCOMES (COs)								
CO1	Ability to analyze Electromagnetic interference effects in PCBs							
CO2	Ability to propose solutions for minimizing EMI in PCBs							
CO3	To understand UMI Test instruments/systems,EMI Test							
CO4	To understand the EMI Control Techniques							
CO5	To understand the EMC Design of PCBs							
Mapping of Course Outcomes with 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			M				
	CO2				L			
	CO3		H					
	CO4		M					
	CO5	L						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I EMI ENVIRONMENT/SPECIFICATIONS /STANDARDS

10

Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters, unit of specifications, Civilian standards, and Military standards.

UNIT-II EMI COUPLING PRINCIPLES

10

Conducted, Radiated and Transient Coupling, common impedance ground coupling, radiated common mode and ground loop coupling radiated differential mode coupling, near field, cable to cable coupling, power mains and power supply coupling.

UNIT-III MEASUREMENTS

8

UMI 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-IV EMI CONTROL TECHNIQUES

8

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, signal Control, Component Selection and mounting.

UNIT-V EMC DESIGN OF PCBS

9

PCB Traces Cross Talk, Impedance Control, Power Distribution decoupling, Zoning, Motherboard Designs and propagation Delay performance models.

TEXT BOOKS:

1. Bernhard Kerker, “Principles of Electromagnetic Compatibility”, Artech house, 3rd Ed 1986.
2. Henry W.Ott, “Noise Reduction Techniques in Electronic Systems”, John Wiley and Sons, New York, 1986.

REFERENCE BOOKS:

1. V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, 1986.

Course Code MVL010	Course Name: OPTIMIZATION TECHNIQUES IN VLSI DESIGN		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					
OBJECTIVES To Know in detail about the optimization techniques and to gain knowledge on Genetic algorithms and To learn implementation of genetic algorithms for VLSI physical design problems and To understand implementation of genetic algorithms for testing of VLSI circuits and technology mapping.						
COURSE OUTCOMES (COs)						
CO1	To Know in detail about the Statistical Modeling					
CO2	To learn implementation of genetic algorithms for VLSI physical design problems					
CO3	To Know in detail about the optimization techniques					
CO4	To understand implementation of genetic algorithms for testing of VLSI circuits					
CO5	To understand implementation of genetic algorithms for technology mapping					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	E
2	CO1		H			
	CO2	M				
	CO3		H			
	CO4				H	

	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I STATISTICAL MODELING

9

Modeling sources of variations, Monte Carlo techniques, Process variation modeling- Pelgrom's model, Principal component based modeling, Quad tree based modeling, Performance modeling-Response surface methodology, delay modeling, interconnect delay models

UNIT II STATISTICAL PERFORMANCE, POWER AND YIELD ANALYSIS

9

Statistical timing analysis, parameter space techniques, Bayesian networks Leakage models, High level statistical analysis, Gate level statistical analysis, dynamic power, leakage power, temperature and power supply variations, High level yield estimation and gate level yield estimation

UNIT III CONVEX OPTIMIZATION

9

Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floor planning, wire sizing, Approximation and fitting- Monomial fitting, Maxmonomial fitting, Posynomial fitting.

UNIT IV GENETIC ALGORITHM

9

Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement,routing technology,Mapping for FPGA- Automatic test generation- Partitioning algorithm Taxonomy-Multiway Partitioning Hybrid genetic-encoding-local improvement-WDFRComparison of Cas-Standard cell placement-GASP algorithm-unified algorithm.

UNIT V GA ROUTING PROCEDURES AND POWER ESTIMATION

9

Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures.Power estimation-application of GA-Standard cell placement-GA for ATG-problem encoding- fitness function-GA vs Conventional algorithm.

TEXT BOOKS:

1. Ashish Srivastava, Dennis Sylvester, David Blaauw "Statistical Analysis and Optimization for VLSI:Timing and Power", Springer, 2005.

2. Pinaki Mazumder, E.Mrudnick, "Genetic Algorithm for VLSI Design,Layout and test Automation", Prentice Hall,1998

REFERENCES BOOK:

1. Stephen Boyd, Lieven Vandenberghe "Convex Optimization", Cambridge University

Course Code MAE015	Course Name: HIGH PERFORMANCE COMMUNICATION NETWORKS		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						
To understand the basics of networks and to study packet switched networks and circuit switched networks and to study ATM ad optical networks						
COURSE OUTCOMES (COs)						
CO1	To develop skills in networking.					
CO2	To gain knowledge in TCP/IP and ISDN concepts.					
CO3	To study Internet And Tcp/Ip Networks					
CO4	To study packet switched networks and circuit switched networks					
CO5	To study ATM ad optical networks					
Mapping of Course Outcomes with 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		M			
	CO2			H		
	CO3	L				
	CO4		H			L
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT-I BASIC OF NETWORKS

9 Telephone, computer, cable Television and Wireless network, Networking principles, Digitalization , service integration, network services, and layered Architecture, traffic characterization and QOS, networks services, network elements and network mechanisms

UNIT-II PACKET SWITCHED NETWORK

9 CSI and IP models: Ethernet (IEEE 802.3), tokenring(IEEE 802.5) FDDI, QDB, frame relay, SMDS, internet working with SMDS

UNIT-III INTERNET AND TCP/IP NETWORKS

9 Interview , internet protocol , TCP and VDP, performance of TCP/IP networks circuit switched networks,SONET , DWDM, Fibre to home ,DSL, Intelligent networks, CATV.

UNIT-IV ATM AND WIRELESS NETWORKS

9

Main features- addressing , signaling and routing , ATM header structure- adaptation layer, management and control, BISDN, Interworking with ATM, Wireless channel, link level design, channel access, Network design and wireless networks.

UNIT-V OPTICAL NETWORKS AND SWITCHING

9 Optical links- WDM systems, cross –connects, optical LAN'S, optical paths and networks, TDS and SDS, modular switch designs- packet switching , distributed, shared, input and output buffers

TEXT BOOKS:

1. Jean Warland and PravinVaraiya, High Performance Communication Networks, 2nd Edition , Harcourt and Morgan Kauffman , London, 2000
2. Leon Gracia, Widjaja , Communication networks, Tata McGraw Hill, New Delhi. 2000

REFERENCES BOOKS

1. SumitKasera, Pankaj sethi, ATM Networks, Tata McGraw Hill, New Delhi 2000
2. Behrouz. a. Forouzan ,Data communication and Networking , Tata McGraw Hill, New Delhi,2000

Course Code MAE014	Course Name: INTERNET WORKING AND MULTIMEDIA	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Multimedia				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES: To introduce the characteristics of text, graphics, video and speech and to teach techniques for efficient transmission of multimedia signals over networks and to introduce different network standards and parameters for quality of service.					
COURSE OUTCOMES (COs)					
CO1	Capability to design efficient protocols for transmission of multimedia signals over networks.				
CO2	Ability to analyze the network performance				
CO3	To study Multicast And Transport Protocol				

CO4	To teach techniques for efficient transmission of multimedia signals over networks.					
CO5	To introduce different network standards and parameters for quality of service.					
Mapping of Course Outcomes with 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			
	CO2	M			M	
	CO3		H			
	CO4			H		L
	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I MULTIMEDIA NETWORKING

9

Digital sound, video and graphics, basic multimedia networking, multimedia characteristics, evolution of Internet services model, network requirements for audio/video transform, multimedia coding and compression for text, image, audio and video.

UNIT II BROAD BAND NETWORK TECHNOLOGY

9

Broadband services, ATM and IP, IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling and policing, throughput, delay and jitter performance.

UNIT III MULTICAST AND TRANSPORT PROTOCOL

9

Multicast over shared media network, multicast routing and addressing, scaping multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP.

UNIT IV MEDIA - ON – DEMAND

9

Storage and media servers, voice and video over IP, MPEG over ATM/IP, indexing synchronization of requests, recording and remote control.

UNIT V APPLICATIONS

9

MIME, Peer-to-peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session philosophy.

TEXT BOOKS :

1. Jon Crowcroft, Mark Handley, Ian Wakeman. Internetworking Multimedia, Harcourt Asia Pvt.Ltd. Singapore, 1998.
2. B.O. Szuprowicz, Multimedia Networking, McGraw Hill, NewYork. 1995

REFERENCES BOOK:

1. Tay Vaughan, Multimedia making it to work, 4ed,Tata McGrawHill, NewDelhi,2000.

Course Code MAE011	Course Name: VLSI 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						
To understand the various VLSI architectures for digital signal processing and To know the techniques of critical path and algorithmic strength reduction in the filter structures and To study the performance parameters, viz. area, speed and power.						
COURSE OUTCOMES (COs)						
CO1	Ability to modify the existing or new DSP architectures suitable for VLSI					
CO2	To know the techniques and algorithmic strength reduction in the filter structures					
CO3	To understand the various VLSI architectures for digital signal processing					
CO4	To study the performance parameters area.					
CO5	To study the performance parameters speed and power					
Mapping of Course Outcomes with 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			
	CO2			M		
	CO3		H			
	CO4	L				
	CO5		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

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

UNIT I INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS 9

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II RETIMING, ALGORITHMIC STRENGTH REDUCTION 9

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT III FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS 9

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV BIT-LEVEL ARITHMETIC ARCHITECTURES 9

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters

UNIT V NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING 9

Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

TEXT BOOKS:

1. Keshab K. Parthi, "VLSI Digital Signal Processing Systems", Design and implementation, Wiley, Inter Science, 1999.

2. S.Y. Kung, H.J. White House, T.Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985.

REFERENCE BOOK:

1. Jose E. France, Yannis Tsividis, "Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

Course Code	Course Name: DSP INTEGRATED CIRCUITS	L	T	P	C
MAE004	Total Contact Hours:45	3	0	0	3
	Prerequisite: Digital Signal Processing				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES To familiarize the concept of DSP and DSP algorithm and Introduction to Multirate systems and finite word length effects and to know about the basic DSP processor architectures and the					

synthesis of the processing elements						
COURSE OUTCOMES (COs)						
CO1	Get to know about the Digital Signal Processing concepts and it’s algorithms Get an idea about finite word length effects in digital filters					
CO2	Concept behind multirate systems is understood					
CO3	Get familiar with the DSP processor architectures and how to perform synthesis of processing elements					
CO4	Acquire an general idea about VLSI circuit layout design aspects					
CO5	To gather an idea about the VLSI circuit layout design styles					
Mapping of Course Outcomes with 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				
	CO2		M		M	
	CO3		H		H	
	CO4	H		H		L
	CO5		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms, Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design.

UNIT II DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS

9

FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters,

Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT III DSP ARCHITECTURES

9

DSP system architectures, Standard DSP architecture-Harvard and Modified Harvard architecture. TMS320C54x and TMS320C6x architecture, Motorola DSP56002 architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures.

UNIT IV SYNTHESIS OF DSP ARCHITECTURES AND ARITHMETIC

9

Synthesis: Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

Arithmetic Unit : Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator.

UNIT V CASE STUDY-INTEGRATED CIRCUIT DESIGN

9

Layout of VLSI circuits, Layout Styles, Case Study : FFT processor, DCT processor and Interpolator.

TEXT BOOK:

1. Lars Wanhammar, “DSP Integrated Circuits”, Academic press, New York, 1999.
2. John J. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education, 2002.
3. B.Venkatramani, M.Bhaskar, “Digital Signal Processors”, Tata McGraw-Hill, 2002.

REFERENCE BOOK:

1. Emmanuel C. Ifeakor, Barrie W. Jervis, “ Digital signal processing – A practical approach”, Tata McGraw-Hill, 2002.
2. Keshab K.Parhi, “VLSI Digital Signal Processing Systems design and Implementation”, John Wiley & Sons, 1999.

Course Code MVL202	Course Name: 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 and					
COURSE OUTCOMES (COs)					
CO1	To know the basics and advanced techniques in low power				
CO2	To design as reduction of power is much needed to enhance the performance of the system				

CO3	To study the design concepts of High power circuits.					
CO4	To understand the various power reduction techniques and the power estimation					
CO5	To study the design concepts of low power 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
2	CO1		M			
	CO2		H			L
	CO3	L				
	CO4			M		M
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Introduction – Simulation – Power Analysis – Probabilistic Power Analysis.

UNIT II ARCHITECTURE

9

Circuit – Logic – Special Techniques – Architecture and Systems.

UNIT III ADVANCED TECHNIQUES

9

Advanced Techniques – Low Power CMOS VLSI Design – Physical of Power Dissipation in CMOS FET Devices.

UNIT IV POWER ESTIMATION

9

Power Estimation – Synthesis for Low Power – Design and Test of Low Voltages – CMOS Circuits.

UNIT V LOW POWER ESTIMATION

9

Low Power Static RAM Architectures – Low Energy Computing Using Energy Recovery Techniques – Software Design for Low Power.

Text Books:

1. Gary Yeap “Practical Low Power Digital VLSI Design”, 1997.

References:

1. Kaushik'Roy, Sharat Prasad, "Low Power VLSI Circuit Design" 2000.

Course Code MVL003	Course Name: ANALOG VLSI DESIGN		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					
OBJECTIVES To study the concepts of CMOS and BICMOS analog circuits and To understand the concepts of A/Dconvertors and analog integrated sensors and To understand the testing concepts in analog vlsi circuits and its statistical modelling.						
COURSE OUTCOMES (COs)						
CO1	To Understand that analog circuits are essential in interfacing and building amplifiers and low p filters.					
CO2	To understand the concepts of A/D convertors and analog integrated sensors					
CO3	To understand the concepts of CMOS and BICMOS analog circuits					
CO4	To understand the testing concepts in analog vlsi circuits.					
CO5	To understand the testing concepts in statistical 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
2	CO1		H			
	CO2		H			
	CO3	L		M		M
	CO4		M		M	
	CO5	M		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Mixed-Signal VLSI Chips-Basic CMOS Circuits-Basic Gain Stage-Gain Boosting Techniques –Super MOS Transistor-Primitive Analog Cells-Linear Voltage-Current converters-MOS Multipliers and Resistors-CMOS, Bipolar and Low BiCMOS Op-Amp Design-Instrumentation Amplifier Design-Low Voltage Filters.

UNIT-II BASIC BICMOS CIRCUIT TECHNIQUES, CURRENT-MODE SIGNAL MESSING AND NEURAL INFORMATION PROCESSING

9

Continuous-Time Signal Processing-Sampled-Data Signal Processing-artiched-current Data Converters-Practical Consideration in SI Circuits Logically-Inspired Neural Networks-Floating-Gate,Low-Power Neural Networks-CMOS Technology and Models-Design Methodology-Networks-contrast Sensitive Silicon Retina

UNIT III SAMPALED-DATA ANALOG FILTERS,OVER SAMPLED A/D CONVERTERS AND ANALOG INTERGRATED SENSORS

9

First-order and second SC Circuits-Bilinear transformation-Cascade Design-Switched-Capacitor Ladder-Synthesis of Switched –Current filter-Nyquist rate A/D converters-Modulators for over Sampled A/D conversion- First and second Order and Multibit Sigma-Delta Modulators-interpolative Modulators-Cascade Architecture-Decimation Filters-Mechanical, Thermal, Humidity and Magnetic Sensors-Sensor interfaces.

UNIT IV DESIGN FOR TESTABLITY AND ANALOG VLSI INTERCONECTORS

9

Faults modeling and Simulation- Testability-Analysis Technique-AdHoc Methods and General Guidelines Scan Techniques-Boundary Scan-Built-in self Test- Analog Test Buses-Design for Election-Beam Testability-Physics of Interconnects in VLSI- Scaling of Interconnects-A Model for Estimating Wiring Density-A Configurable Architecture for Prototyping analog Circuits.

UNIT V STATISTICAL MODELLING AND SIMULATION, ANALOG COMPUTER-AIDED DESIGN AND ANALOG AND MIXED ANALOG-DIGITAL LAYOUT

9

Review of statistical concepts- statistical Device Modeling-Statistical Circuit Simulation-Automation Analog Circuit Design-Automatic Analog Layout-CMOS Transistor layout-Resistor Layout-Capacitor Layout-Analog Cell Layout-Mixed Analog-Digital Layout.

TEXT BOOKS:

1. "Analog VLSI Signal and information Processing",Mohammed Ismail,Terri Fiez, McGraw-Hill International Editions,1994.

REFERENCE BOOK:

1. Malcom R. Haskard, Lan C. May, "Analog VLSI Design- NMOS and CMOS", Prentice hall,1998.
2. Randall I. Geiger, Phillip & Allen, Neol K. Strader, "VLSI Design Techiniques for Analog and Digital Circuits", McGraw Hill International Company,1990
3. Jose E. France, Yannis Tsvividis, "Design of Analog-Digital VLSI Circuits for Telecommunications and Signal Processing," Prentice Hall, 1994

Course Code	Course Name: EMBEDDED SYSTEMS	L	T	P	C
MED102	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Microprocessor and its Application				
		Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES						
To know about the concepts of embedded hardware and to know in detail about PIC microcontroller.						
COURSE OUTCOMES (COs)						
CO1	To understand about the basics of embedded system and its software environment					
CO2	To design embedded system for real time applications.					
CO3	To know in detail about embedded microcontroller.					
CO4	To discuss about the software environment in embedded systems.					
CO5	To learn about real time operating 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		
	CO2				H	
	CO3		L			
	CO4			M		
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I INTRODUCTION REVIEW OF EMBEDDED HARDWARE

9

Terminology Gates – Timing Diagram – Memory – Microprocessors Busses – Direct Memory Access – Interrupts – Built – Ins on the Microprocessor – Conventions used on Schematic – Interrupt Microprocessor Architecture – Shared Data Problem – Interrupt Latency.

UNIT – II PIC MICROCONTROLLER AND INTERFACING

9

Introduction – CPU Architecture – Registers – Instruction Sets Addressing Modes – Loop Timers - Interrupts – Interrupt Timing I/O Expansion – 12C Bus Operation Serial EEPROM – Analog to Digital Converter – UART Baud Rate – Data Handling – Initialization – Special Features – Serial Programming – Parallel Slave Port.

UNIT – III EMBEDDED MICROCONTROLLER SYSTEMS

9

Motorola MC68H11 Family Architecture Registers - Addressing Modes – Programs – Interfacing Methods – Parallel I/O Interface – Parallel Port Interface – Memory Interfacing – High Speed I/O Interfacing - Interrupts – Interrupt SERVICE Routing – Features of Interrupts – Interrupt Vector and Priority – Timing Generation and Measurement – Input Capture – Output Compare – Frequency Measurement – Serial I/O Devices RS232, RS485 – Analog Interfacing – Applications.

UNIT – IV SOFTWARE DEVELOPMENT AND TOOLS

9

Embedded System Evolution Trends – Round – Robin with Interrupts – Function – One – Scheduling Architecture – Algorithms – Introduction to Assembler – Compiler – Cross Compilers and Integrated Development Environment (IDE) – Object Oriented Interfacing – Recursion – Debugging Strategies – Simulators.

UNIT – V REAL TIME OPERATING SYSTEMS

9

Task and Task States – Tasks and Data – Semaphores and Shared Data Operating System Services – Message Queues – Timer Function – Events – Memory Management – Interrupt Routines in an RTOS Environment – Basic Design Using RTOS.

TEXT BOOKS:

1. David E. Simon, “An embedded Software Primer” Pearson Education Asia, 2001.
2. John B Peat man “Design with Microcontroller” Pearson Education Asia, 1998.
3. Jonathan W. Volcano Brooks/Cole “Embedded Micro Computer Systems. Real Time Interfacing”. Thomson Learning 2001.

REFERENCES BOOK:

1. Burns, Alan and Welling, Andy, “Real - Time Systems and Programming Languages”, Second Edition, Harlow: Addison – Wesley – Longman, 1997
2. Raymond J. A. Blur and Donald L. Bailey, “Introduction to Real Time Systems: Design to Networking with C/C++” Prentice Hall Inc. New Jersey, 1999
3. Graham Moore, and Cylix, “Real – Time Programming: A Guide to 32 Bit Embedded Development. Reading” Addison - Wesley – Longman, 1998.

Course Code MED201	Course Name: ASIC DESIGN		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Basic ASIC					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES To learn the fundamentals of ASIC and its design methods						
COURSE OUTCOMES (COs)						
CO1	To gain knowledge about partitioning					
CO2	To analyses the synthesis					
CO3	To gain knowledge on programmable architectures for ASICs					
CO4	To understand the physical design of ASIC.					
CO5	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
2	CO1			H		

	CO2			M		
	CO3				L	
	CO4		M			
	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

Ant fuse – Static RAM – EPROM and EEPROM Technology – PREP Bench Marks – Acted ACT – Xilinx LCA – Altags 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.

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH-EMBEDDED SYSTEM DESIGN
(FULL TIME)
I – IV SEMESTERS

SEMESTER-I					
Sub Code	Subject Name	L	T	P	C
Theory					
MMA101	Applied Mathematics for Electronics Engineers	3	1	0	4
MES101	Microcontroller Based System Design	3	0	0	3
MES102	Embedded Systems	3	0	0	3
MAE102	Advanced Digital System Design	3	0	0	3
MES1E1	Elective-I	3	0	0	3
Practical					
MES1L1	Embedded System Design Lab-I	0	0	4	2
Total Credits:					18
SEMESTER-II					
Sub Code	Subject Name	L	T	P	C
Theory					
MES201	ASIC Design	3	0	0	3
MES202	Software Technology for Embedded System	3	0	0	3
MES203	Real Time Systems	3	0	0	3
MES2E2	Elective-II	3	0	0	3
MES2E3	Elective-III	3	0	0	3
Practical					
MES2L2	Embedded System Design Lab-II	0	0	4	2
Total Credits:					17

SEMESTER-III					
Sub Code	Subject Name	L	T	P	C
Theory					
MES3E4	Elective-IV	3	0	0	3
MES3E5	Elective-V	3	0	0	3
MES3E6	Elective-VI	3	0	0	3
MES3P1	Project work phase-I	0	0	12	6
Total Credits:					15

SEMESTER-IV					
Sub Code	Subject Name	L	T	P	C
MES4P2	Project work phase-II	0	0	24	12
Total Credits:					12

TOTAL CREDITS FOR THE PROGRAMME-62

Sub Code	LIST OF ELECTIVES	L	T	P	C
MED 001	Design of Embedded System	3	0	0	3
MED 002	Embedded Control System	3	0	0	3
MED 003	Computer Vision and Image Understanding	3	0	0	3
MED 004	Distributed Embedded Computing	3	0	0	3
MED 005	Design of Digital Control System	3	0	0	3
MED 006	Crypto Analytic Systems	3	0	0	3
MED 007	Intelligent Embedded Systems	3	0	0	3
MED 008	Real Time Operating System	3	0	0	3
MED009	Advanced Microprocessors	3	0	0	3
MED010	Artificial Intelligence and Expert systems	3	0	0	3
MED011	Advanced Digital Signal Processing	3	0	0	3
MED012	Computer Architecture and parallel processing	3	0	0	3
MED013	Design of semiconductor Memories	3	0	0	3
MED014	VLSI Architecture and Design methodologies	3	0	0	3
MED015	Introduction to VLSI Design	3	0	0	3
MST070	Research Methodology	3	0	0	3

SEMESTER-I**MMA101 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS 3 1 0 4****Course Objective:**

- To apply all taught techniques to unseen problems,
- Queuing is a major branch of optimization, Random variable compute and interprets means.
- Correlation/covariance, PERT and CPM chart is mainly used for documenting the data(visually) on projects.

Course Outcomes:

After successful completion of this course, the students should be able to

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, control and signal processing.

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.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M									
CO2		M		W	S	W						
CO3			S		M							
CO4	M			M								
CO5												

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 : QUEUEING THEORY

12

Single and Multiple Server Markovain Queuing Models – Customer Impatience Priority Queues M/g / I Queuing System –Queuing Applications

Total Periods: 60 Hours

Reference 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. Steart G.W. “Introduction to Matrix Computaions“ Academic Press, New York.
4. Handy A.Taha., “Operations Research An Introduction”, 7th Edn. Pearson Education , Chennai-113. 2002.
5. Donald Gross and Carl M. Harris, “Fundamentals of Queuing Theory”, 2nd Edn. Wiley India Pvt Ltd, New Delhi.

MES101 MICROCONTROLLER BASED SYSTEM DESIGN

3 0 0 3

Course Objectives:

- To teach I/O and RTOS role on microcontroller.
- To impart knowledge on PIC Microcontroller based system design.
- To introduce Microchip PIC 8 bit peripheral system Design
- To give case study experiences for microcontroller based applications.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: review 8-bit microcontrollers

CO2: learn assembly and C-programming of PIC

CO3: learn Interfacing of Microcontroller

CO4: get familiar with real time operating system

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	S	M		M	W		S	M				
CO2	M		M	M	S		M		M			
CO3	S	M		S	M		S	M				
CO4	S	M		M	M							

UNIT-I **9**
INTEL8051

Architecture of 8051 - memory organization - register banks - register banks - bit addressable area - SFR area - addressing modes - instruction set - programming examples.

UNIT-II **9**

8051 interrupt structure – timer modules – serial features – port structure – power saving modes – family features; 8031/8071.

UNIT-III **9**

MOTOROLA 68HC11;

68HC11 features – different modes of operation and memory map – functions of I/O ports in single chip and expanded multiplexed mode-timer system of 68HC11.

UNIT-IV **9**

Input capture, output compare and pulsed accumulator features of 68hc11-serial peripheral and serial communication interface – analog to digital conversion features- - watchdog features.

UNIT-V **9**

8096 CONTROLLER

Architecture of 8096 – modes – block diagram of interrupt structure – timers – high speed input and outputs – PWM output – analog interface – serial ports.

TYPICAL APPLICATION:

Stepper motor control – dc motor control – AC power control – introduction to microcontroller development tools.

Total Periods: 45 Hours

Reference Books:

1. The 8051 Microcontroller Based Embedded Systems Paperback – 14 May 2014by Manish K Patel.
2. "8 – bit embedded controllers", INTEL corporation 1990.
3. " 16 – bit embedded controllers hand book", INTEL corporation 1989.
4. JOHN B Peatman,"desigh with Microcontroller",Mc Grew Hill, Singapore

Course Objectives:

- To know about the concepts of embedded hardware.
- To know in detail about PIC microcontroller.
- To know in detail about embedded microcontroller.
- To discuss about the software environment in embedded systems.
- To learn about real time operating systems.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To understand about the basics of embedded system and its software environment

CO2: To design embedded system for real time applications.

CO3: Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.

CO4: Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level)

CO5: Become aware of interrupts, hyper threading and software optimization.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M									
CO2		M		W	S	M	S	M				
CO3			S		M							
CO4	M			M			M					
CO5												

UNIT – I**INTRODUCTION REVIEW OF EMBEDDED HARDWARE****9**

Terminology Gates – Timing Diagram – Memory – Microprocessors Busses – Direct Memory Access – Interrupts – Built – on the Microprocessor – Conventions used on Schematic – Schematic. Interrupt Microprocessor Architecture – Shared Data Problem – Interrupt Latency.

UNIT – II**UNIT PIC MICROCONTROLLER AND INTERFACING****9**

Introduction – CPU Architecture – Registers – Instruction Sets Addressing Modes – Loop Timers - Interrupts – Interrupt Timing I/O Expansion – 12C Bus Operation Serial EEPROM – Analog to Digital Converter – UART Baud Rate – Data Handling – Initialization – Special Features – Serial Programming – Parallel Slave Port.

UNIT – III**EMBEDDED MICROCONTROLLERSYSTEMS****9**

Motorola MC68H11 Family Architecture Registers - Addressing Modes – Programs – Interfacing Methods – Parallel I/O Interface – Parallel Port Interface – Memory Interfacing – High Speed I/O Interfacing - Interrupts – Interrupt Service Routing – Features of Interrupts – Interrupt Vector and Priority – Timing Generation and Measurement – Input Capture – Output Compare – Frequency Measurement – Serial I/O Devices RS232, RS485 – Analog Interfacing – Applications.

UNIT – IV

SOFTWARE DEVELOPMENT AND TOOLS

9

Embedded System Evolution Trends – Round – Robin with Interrupts – Function – One – Scheduling Architecture – Algorithms – Introduction to Assembler – Compiler – Cross Compilers and Integrated Development Environment (IDE) – Object Oriented Interfacing – Recursion – Debugging Strategies – Simulators.

UNIT –V

REAL TIME OPERATING SYSTEMS

9

Task and Task States – Tasks and Data – Semaphores and Shared Data Operating System Services – Message Queues – Timer Function – Events – Memory Management – Interrupt Routines in an RTOS Environment – Basic Design Using RTOS.

Total Periods: 45 Hours

Text books:

1. Embedded Systems: Introduction to Arm(r) Cortex -M Microcontrollers: 1Paperback – Import, 26 May 2012by Jonathan W Valvano (Author)
2. David E. Simon, “An embedded Software Primer” Pearson Education Asia, 2001.
3. John B Peat man “Design with Microcontroller” Pearson Education Asia, 1998.
4. Jonathan W. Volcano Brooks/Cole “Embedded Micro Computer Systems. Real Time Interfacing”. Thomson Learning 2001.
5. Embedded systems: architecture, programming and design paperback – 11 Jun 2008by Raj Kamal (Author)

Reference Books:

1. Burns, Alan and Welling, Andy, “Real - Time Systems and Programming Languages”, Second Edition, Harlow: Addison – Wesley – Longman, 1997
2. Raymond J. A. Blur and Donald L. Bailey, “Introduction to Real Time Systems: Design to Networking with C/C++” Prentice Hall Inc. New Jersey, 1999
3. Graham Moore, and Cylix, “Real – Time Programming: A Guide to 32 Bit Embedded Development. Reading” Addison - Wesley – Longman, 1998.
4. Heath. Steve, “Embedded Systems Design”, Newness1997.

- To learn the concepts of theorems and other techniques to design minimized logic functions.
- To Understand the concepts of synchronous and asynchronous sequential circuit design
- To learn about the faults in logic circuits and methods of diagnosing it.
- To learn about programmable logic devices.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: The candidate should after this course have an in-depth knowledge of digital integrated circuit hardware design.

CO2: The emphasis is on FPGA technology, but most of the design techniques can also be applied to ASIC devices.

CO3: The student should be familiar with the latest state-of-the-art system on chip (SoC) design methodologies, including high-level synthesis and partial run-time reconfiguration.

CO4: Students should be able to learn the benefits and drawbacks of the various design methods for solving a problem.

CO5: Through practical assignments, experience will be achieved from both using tools as well as designing their own system.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							S					
CO2		S	S	M	M				S	M		
CO3	S					M			M			
CO4		M	S	W		S			S	M		
CO5	S				M							

UNIT-1

ADVANCED TOPICS IN BOOLEAN ALGEBRA

9

Shannon's expansion theorem, Consensus theorem, Octal designation, Run measure, INHIBIT/INCLUSION/AOI/Driver /Buffer gates ,Gate expander, Reed Muller expansion, Synthesis of multiple output combinational logic circuits by product map method ,Design of static hazard free and dynamic hazard free logic circuits.

UNIT-II

THRESHOLD LOGIC

9

Linear separability, Unateness, Physical implementation, Dual comparability, reduced function, various theorems in threshold logic, Synthesis of single gate and multigate threshold Network

UNIT-III

SYMMETRIC FUNCTIONS

9

Elementary symmetric functions, partially symmetric and totally symmetric functions, McCluskey decomposition method, Unity ratio symmetric ratio functions, Symmetric ratio functions, Synthesis function by contact networks.

UNIT-IV

SEQUENTIAL LOGIC CIRCUITS

9

Mealy machine, Moore Machine, Trivial/ Reversible /Isomorphic sequential machines, state diagrams, State table minimization incompletely specified sequential machines ,State assignments ,Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode, Essential Hazards.

UNIT-V

PROGRAMMABLE LOGIC DEVICES

9

Basic concepts, Programming technologies, Programmable Logic Element(PLE),Programmable Logic Array(PLA),System Design using PLD's-Design of combinational and sequential circuits using PLD's(CPLD).Programming PAL device using PALSAM ,Design of state machine using Algorithmic State Machines (ASM) chart as a design tool, Introduction to Field Programmable Gate Arrays –Types of FPGA, Xilinx XC 3000 series, Logic Cell Array (LCA),Configurable Logic Blocks(CLB) INPUT/OUTPUT Block(IPB)-Programmable Interconnect Point (PIP),Introduction to Actel AACT2 FAMILY AND XILINX XC 4000 families ,Design examples.

Total Periods: 45 Hours

Reference Books:

1. William I.Fletcher, “An Engineering Approach to Digital Design”, PrenticeHall of India.
2. James E.Palmer, David E.Perlman, “Introduction to Digital Systems”, Tata McGraw Hill, 1996.
3. N.N.Biswas, “Logic Design Theory “, Prentice Hall of India, 1993
4. S.Devadas, A.Ghosh and K.Keutzer, “Logic Synthesis”, McGraw Hill, 1994.

MES1L1 EMBEDDED SYSTEM DESIGN LAB-1

0 0 4 2

(EXPERIMENTS SHOULD BE DONE USING PIC/8051 MICROCONTROLLER)

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.

Course outcomes:

After successful completion of this course, the students should be able to

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

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S		S			S	M		S	
CO2	S	M			S			S	M		S	
CO3	M		M		S			S	M		S	
CO4	S	M			S			S	M		S	
CO5	S	M			S			S	M		S	

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

MES201 ASIC DESIGN**3 0 0 3****Course objectives:**

- To learn the fundamentals of ASIC and its design methods
- To gain knowledge on programmable architectures for ASICs
- To understand the physical design of ASIC.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.

CO2: To analyse the synthesis, Simulation and testing of systems.

- CO3:** Describe the different phases of the design flow for digital ASICs.
- CO4:** Explain how non-functional design constraints affect the design process.
- CO5:** Categorize different types of ASICs and explain their technology.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M								
CO2	S	M	M		S	S			S	M		
CO3				S	W			S	M		M	
CO4		S	W		M	W	S		S	M		
CO5	M								S	M		

UNIT – I 9

INTRODUCTION TO ASIC, CMOS LOGIC AND ASIC LIBRARY DESIGN

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 9

PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS.

Ant 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 9

PROGRAMMABLE ASICS INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY.

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 9

ASICS CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING.

System Partition – FPGA Partitioning – Partitioning Methods – Floor Planning – Placement – Physical Design Flow – Global Routing – Detailed Routing – Special Routing –Circuit Extraction – DRC.

Total Periods: 45 Hours

Text Books:

1. M. J. S. Smith, “Application Specific Integrated Circuits” , Addison – Wesley L Onnam Inc., 1997.
2. A Guide to Modern ASIC Design: From Register Transfer Level to Logic Synthesis Hardcover – Import, 1 Jun 2010by Victor X. Q. Yu (Author), Albert T. L. Lee (Author), Philip C. H. Chan (Author)

Reference Books:

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.
5. Jose E. France, Yantis Tsvividis, “Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing”, Prentice Hall, 1994.

MED202 SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS 3 0 0 3

Course Objectives

- To demonstrate professional advancement through significant technical achievements and expanded leadership responsibility;
- Demonstrate the ability to work effectively as a team member and/or leader in an ever-changing professional environment; and
- Progress through advanced degree or certificate programs in computing, science, engineering, business, and other professionally related fields.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify and understand the working of key components of a computer system (hardware, software, firmware etc).

CO2: Understand computing environment, how computers work and the strengths and limitations of computers.

CO3: Identify and understand the various kinds of input-output devices and different types of storage media commonly associated with a computer.

CO4: Identify and understand the representation of numbers, alphabets and other characters in computer system.

CO5: Understand, analyze and implement software development tools like algorithm, pseudo codes and programming structure.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M				S	M			
CO2	S	M	M		S	S		M		M		
CO3				S	W			S	M			
CO4		S	W		M	W	S	S	M			
CO5	M											

UNIT-I

9

LOWERLEVEL PROGRAMMING IN C

Primitive data types – functions – recursive functions – pointers – structures – unions – dynamic memory allocations – pipe handling – linked lists.

UNIT –II

9

C AND ASSEMBLY

Programming in assembly – register usage conversions – typical use of addressing options – instruction sequencing – procedure call and return – parameter passing – retrieving parameters – everything in pass by value – temporary values.

UNIT-III

9

OBJECT- ORIENTED ANALYSIS AND DESIGN

Connecting the object model with the use case model – key strategies for objects identification – underline the noun strategy – identify the casual objects – identity services (passive contributors)- identity real – world items – identity physical devices – identity key concepts – identity transactions – identity persistent information – identity visual elements – identity control elements – apply scenarios.

UNIT-IV

UNIFIED MODELING LANGUAGE

9

Object state behavior – UML state charts – role of scenarios in the definition of behavior – timing diagrams – sequence diagrams - event hierarchies – types and strategies of operations – architectural design in UML concurrent design – representing tasks – system task diagram – concurrent state diagrams – threads – mechanistic design – design simple patterns.

UNIT-V

CASE STUDIES

9

Multi threaded applications – assembling embedded applications – polled waiting loop and interrupt driven I/O – preemptive kernels and shared resources – system timer – scheduling – client server computing.

Total Periods: 45 Hours

Reference Books:

1. Bruce Powel Douglas, “real – time UML”, 2nd edition :developing efficient objects for embedded systems (the Addison- Wesley object technology series)”, 2nd edition (October 29, 1999), ADDISON – Wesley.
2. Hassan gomma, “design concurrent, distributed and real – time applications with UML.
3. Daniel W.lewis,”fundamentals of embedded software where cand assembly meet “ PHI 2002.

MES203

REAL TIME SYSTEMS

3 0 0 3

Course Objectives

- To expose the students to the fundamentals of Real Time systems
- To teach the fundamentals of Scheduling and features of programming languages
- To study the data management system for real time
- To introduce the fundamentals of real time communication
- To teach the different algorithms and techniques used for real time systems

Course Outcomes

After successful completion of this course, the students should be able to

CO1: explain and apply the fundamental concepts and terminology of real-time systems;

CO2: explain and address the fundamental problems of real-time systems;

CO3: analyze real-time systems designs;

CO4: design a real-time system (at least partially); and

CO5: identify and assess the relevant literature and research trends of real-time systems.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M					M		S	
CO2	S	M	M		S	S				S	W	
CO3				S	W			S	W		M	
CO4		S	W		M	W	S		M		S	
CO5	M											

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 – time error handling – overloading and generics – multi tasking – low-level programming – task scheduling – timing specifications – programming environment – run-time support – code generation.

UNIT-III

REAL TIME DATA BASES

9

Real time data base- basic definition – real time 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

EVALUATION 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, 1987.

MES2L2

EMBEDDED SYSTEM DESIGN LAB LAB-II

0 0 4 2

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.

Course Outcomes:

After successful completion of this course, the students should be able to

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 flipflops

CO5: To design and Test of counters and registers

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	S	S	S		S			S	M		S	S
CO2	M		S		S			S	M		S	S
CO3		S	W					S	M		S	S
CO4	W		M					S	M		S	S
CO5	M		S		S			S	M		S	S

List of Experiments

A. Vx WORKS – RTOS LAB

1. Thread Management.
2. Pipes, Message Queue & Semaphoke.
3. Ram Disk And File System.
4. Memory Management & Watching Timer.

B. VHDL LAB

1. Design of Basic Gates, Address & Subtactxters.
2. Design of Mux, Demux, Encoder, Decoder & Synchronous Counter.
3. Design of Parallel Adder, Comparator, Flip- Flops, Shift Register & Ram
4. Design of A/D Converter Using FGFA Kit

ELECTIVES

MES001 DESIGN OF EMBEDDED SYSTEMS

3 0 0 4

Course Objectives

- To provide a clear understanding on the basic concepts, Building Blocks for
- Embedded System
- To teach the fundamentals of System design with Partioning

- To introduce on Embedded Process development Environment
- To study on Basic tool features for target configuration
- To introduce different EDLC Phases & Testing of embedded system

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Compare embedded system design models using different processor technologies (single-purpose, general-purpose, application specific processors).

CO2: Describe and compare the various types of peripherals used in embedded systems.

CO3: Analyze a given embedded system design and identify its performance critical points.

CO4: Use modern engineering tools necessary for integrating software and hardware components in embedded system designs.

CO5: Utilize a top-down modular design process to complete a medium complexity embedded system design project under instructor specified design constraints.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M		M		S				
CO2	S	M	M		S		S	W				
CO3				S	W	W		M				
CO4		S	W		M	M		S				
CO5	M											

UNIT-I

INTRODUCTION

9

Embedded computing – characteristics of embedded computing applications- embedded system design challenges – constraint driven design – IP – based – hardware – software co –design

UNIT – II

DEVELOPMENT ENVIRONMENT

9

The Execution Environment- memory organization – system space – code space – Data space – unpopulated memory space –i/o space – system start – up – interrupt Response cycle – Function calls and stack frames- run time environment- object placement

UNIT-III

9

EMBEDDED COMPUTING PLATFORM

CPU bus – memory devices –I/O devices –component interfacing- designing with microprocessors- development and debugging- design example –design patterns – dataflow graphs –assembly and linking – basic compilation techniques –analysis and optimization

9

Inter-process communication –signals – signals in UML- shared memory communication- accelerated design- design for video accelerator- networks for embedded systems –networks based design- internet enabled systems

9

Design methodologies and tools – design flows – designing hardware and software components
– requirements analysis and architecture design – system integration – structural and behavioral
description – case studies

References:

1. Morgon Kaufman Publishers
2. Jean J. Labrosse, "Embedded system Building blocks ; complete and ready to use modules in C"

3 0 0 3

- 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

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

C03: Develop software programs to control embedded system

CO4: Generate product specification for embedded system

CO5: Outline validation and testing methodologies for embedded system

[illegible]

Controlling the hardware with software – data lines number systems address lines schematic representation hit masking programmable peripheral interlace Switch input detection.

Keyboard basic – keyboard scanning algorithm – multiplexed LED displays – character LCD modules- LCD module display – configuration – time – of- day – clock – timer manager interrupts – interrupt service routines – IRQ-ISR-interrupt vector or dispatch table multiple point – interrupt – driven pulse width modulation.

R-2R ladder – more on op – amps – virtual ground – resistor 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.

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.

Multiple closure problems – basic outputs with PPI – controlling motors – bidirectional control of motors – H bridge – telephonic systems – burglar alarms – fire alarms – inventory control systems.

References Books:

1. Jean J. Labrosse,” Embedded Systems Building Blocks: Complete and Ready_to_Use Moduyles in C,”the Publisher, Paultemme, 1999,
2. Ball S.R, “Embedded Microprocessor Systems_Real World Design”, Prentice Hall,1996.
3. HermaK,”Real Time Systems_Design For Distributed Embedded Applications ‘ ‘ Kulwer Academic , 1997.
4. Daniel W.Lewis,” Fundamental Of Embedded Software Where C And Assembly Meet’’ PHI 2002.

Course Objectives

- To introduce students with practice and theory of computer vision
- To give basics of pattern recognition concepts with applications to computer vision
- To provide students with necessary theory and skills for automatic analysis of digital images, and thereby to construct representations of physical objects and scenes, and to make useful decisions based on them

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Understand image formation and the role human visual system plays in perception of gray and color image data.
- CO2:** Get broad exposure to and understanding of various applications of image processing in industry, medicine, and defense applications
- CO3:** Learn the signal processing algorithms and techniques in image enhancement and image restoration.
- CO4:** Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.
- CO5:** Be able to conduct independent study and analysis of image processing problems and techniques.

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		W			M	S		M	
CO2	S	M		S	M	S					M	
CO3	S		S	W						M		
CO4		W		M								
CO5		M		S								

UNIT-I DIGITAL IMAGE FUNDAMENTALS

9

Histogram transforms - walshhadamard transform- discrete cosine – hotelling transform – image formation and file formats

UNIT-II IMAGE ENHANCEMENT

9

Histogram modification techniques – image smoothening – image sharpening – image restoration – degradation model – diagonalisation of circuit and block circulant matrices – algebraic approach to restoration

UNIT-III IMAGE COMPRESSION AND SEGMENTATION

9

Compression models – element of information theory – error free compression – image segmentation – detection of discontinuities – edge linking and boundary detection – threshold – regions oriented segmentation - morphology

UNIT-IV FEATURE EXTRACTION

9

Image feature description – interpretation of line drawings – image pattern – recognition algorithms

UNIT-IV KNOWLEDGE REPRESENTATION AND USAGE

9

Knowledge representation and usage – image analysis knowledge about scenes – image understanding using two dimensional methods.

Total Periods: 45 Hours

References

1. GONZALEZ .R & woods B.E “Digital Image Processing”, Addison Wesley, 1993
2. ANIL Jain .K “Fundamental Digital Image Processing” Prentice Hall Of India 1983

MES004 DISTIBUTED EMBEDDED COMPUTING

3 0 0 0

Course Objectives

- To understand the hardware infrastructure of distributed systems.
- To study concepts of Internet and Embedded agent.
- To obtain basic knowledge distributed computing using Java.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand network protocol layers and explain the specific role of each.

CO2: Complete design of an embedded system with functional requirements for hardware and software components 3.Develop software systems for measurement of embedded system operating characteristics (for example, latency, data transport rate, error rate).

CO3: Completed a subsystem and integrate this with a complete system to perform a complex task involving networked, mobile, embedded systems.

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		W			M	S		M	
CO2	S	M			M	S					M	
CO3	S									M		

UNIT-I

THE HARDWARE INFRASTRUCTURE

9

Board band transmission facilities – open interconnection standards – local area networks – wide area networks – network management – network security – cluster computers.

UNIT-II

SOFTWARE ARCHITECTURE

9

client - server architecture - challenges - design methodology – intranets and group ware – hardware and software for intranet – group and features – network as a computer – the internet – IP addressing – internet security – open systems – concepts and reliability.

UNIT-III

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 the active components.

UNIT-IV

DISTRIBUTED COMPUTING USING JAVA

9

10 streaming – object serialization – networking – threading – RMI – multicasting – distributed databases – embedded java concepts – case studies.

UNIT-V

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.

Total Periods: 45 Hours

References

1. Dietel & Dietel, “Java How To Program”, Prentice Hall 1999
2. Sapemullender,”Distributed Systems”, Addison-Wesley, 1993
3. George Coulouris And Jean Dollimore,”Distributed Systems – Concepts And Design”, Addison – Wesley 1998
4. “Architecture and Design Of Distributed Embedded Systems”, Edited By Berndkleinjohann C- Lab, University Paderhorn, Germany, Kluwyer Academic Publishers, Boston, April 2001, 248pp.

MES005 DESIGN OF DIGITAL CONTROL SYSTEM 3 0 0 3

Course Objectives

- To learn the fundamental principles of feedback control and dynamic systems
- To acquire the concepts of Optimal Control Systems and Digital Control Systems
- To Model and control hybrid systems
- To learn how to perform the stability analysis of Feedback Control Systems

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Be familiar with The Design of Feedback Control Systems employing the previously learnt techniques such as the Bode Diagram, and the Root Locus method.
- CO2:** Become familiar with issues faced in sampling, digital data and discrete time systems.
- CO3:** Acquire the concepts of the Stability in the Frequency Domain employing The Nyquist Criterion, the Relative Stability, and Time Domain Performance Criteria in the Frequency Domain.
- CO4:** able to apply advanced technical knowledge in multiple contexts
- CO5:** able to understand and design advanced electronics systems (Analog and Digital Systems) and conduct experiments, analyze and interpret data

CO/PO Mapping	
	(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		W			M	S		M	
CO2	S	M			M		S	M			M	
CO3	S					S	W			M		
CO4	M	M		M	W		M	W	S	M		
CO5	M				M		S	M				

UNIT-I INTRODUCTION

9

Effect of sampling – review of continuous control systems – modeling – control design - time and frequency domain techniques.

UNIT-II DISCRETE TIME SYSTEMS

9

Analysis of discrete time systems – difference equations – Z – transforms – time and frequency response – sample data systems – sample and hold – sampling and extrapolation – A/D and D/A conversion of systems.

UNIT-III DESIGN USING TRANSFORM AND STATE SPACE TECHNIQUES

9

Methods of discretisation – comparison – direct design frequency response methods state space design – controllers/estimator design – controllability and observability

UNIT-IV QUANTIZATION EFFECT AND SAMPLE RATE SELECTION

9

Analysis of round off error – parameter round off – limit cycles and dither – sampling theorem limit – time response and smoothness – sensitivity to parameter variation – quantization noise and analyzing filter – multi – rate sampling.

UNIT-V COMPUTER BASED CONTROL

9

Selection of processors – mechanization of control algorithms – PID control law – merits and demerits of various algorithms – applications to temperature control – design of DD systems – stepper motors and motor controllers and stepper motor control systems.

Total Periods: 45 Hours

Reference Books:

1. GopalM, "digital control engineering", wiley eastern, 1989
2. K. Ogata, "discrete time control systems", PHI 1987
3. Frosythe and W. Goodale, "digital control", McMillan, 1991

MES006 CRYPTO ANALYTIC SYSTEMS

3 0 0 3

Course Objectives:

- To know about various encryption techniques.
- To understand the concept of Public key cryptography.
- To study about message authentication and hash functions

- To impart knowledge on Network security
- To learn the basic concepts of system level security

Course Outcomes:

After successful completion of this course, the students should be able to

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.

COs	CO/PO Mapping											
	(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		W			M	S		M	
CO2	S	M			M	S					M	
CO3	S									M		
CO4	M	M		M	M	S		M	S	M		
CO5	M				M			M				

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

UNIT-II

CRYPTOGRAPHY

9

Basic encryption and decryption – mono alphabetic ciphers – polyalphabetic submission – transpositions – fractional Morse – stream and block ciphers-characteristics of good ciphers – secure encryption systems – public key system – single key system – data encryption standard – rivest – 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 SECURITY

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

COMMUNIOICATION 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

Text books

1. William Stallings Cryptography And Network Security Principles And Practice, PHI 1998
2. Charles, P. Pleegeer, Security In Computing, PHI, 1998

Reference Books

1. Hans, Information And Communiocation Security, Springer Verlag, 1998
2. Simonds, Network Security, McGraw Hill, 1998
3. Derek Atkins, Internet Security, Techmedia, 1998
4. Kernel Texplan, Communication Network Management, PHI,1992.

MES007 INTELLIGENT EMBEDDED SYSTEMS

3 0 0 3

Course Objectives:

- The course aims to give the student an opportunity to integrate theoretical and practical competence relevant for research and development of embedded and intelligent systems.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Program an embedded computer implementing functions for situation and position estimation, motor control and wireless communication in a distributed system.

CO2: Apply and use sensors and techniques for calibration altering and combination of signals from different sensors.

CO3: Use skills in own specialization area in project work and cooperate with other specialists.

CO4: Use modern engineering tools necessary for integrating software and hardware components in embedded system designs.

COs	CO/PO Mapping											
	(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		W			M	S		M	
CO2	S	M		S	M	S					M	

CO3	S		S	W						M		
CO4	M	W		M	M	S		M	S	M		
CO5	M	M		S	M			M				

UNIT-I INTRODUCTION

9

Overview of agent based intelligent inhabited environments such as intelligent buildings introduction to the embedded – internet. Embedded agents and intelligent inhabited environments using examples from notable work-topologies for intelligent inhabited environments – brief review of control methods – behavior based embedded-agent – Agent and system intelligence (e.g. Reactivity versus and deliberation)

UNIT-II EMBEDDED_AGENT DESIGN

9

Embedded – agent design criteria and issues – considerations of various solutions, in particular behavior based methods, which are the prime focus of the course behavior based agent (BBA) mechanism implementing reactive functionality in embedded agents – knowledge in embedded agents – behavior based agents (BBA) mechanisms for implementing deliberative functionality in embedded agents

UNIT-III MULTITEMBEDDED AGENTS

9

Overview of multi embedded – agents infrastructure including networking standards for intelligent buildings – embedded agent co-ordination, mechanisms and bench marks embedded agents

UNIT-IV HUMAN-MACHINE

9

HMI interfacing issues in intelligent inhibited environments and their relationship to cognitive disappearance – individually commercial issues – technical design consequences arising from social issues such as privacy, Asimov –like rules

UNIT-VHIGH-END APPLICATIONS

9

Case studies self-directed deep space probes – robotic soccer teams- underwater submarines – acrobatic helicopters and mobile robots.

Total Periods: 45 Hours

Reference Books

1. ArkinR.C,”Behavior –Based Robotics”, The MIT Press, 1998
2. Rievski. G,”Mechantronics” Designing Intelligent Machines” Butterworth Heinmann, 1995
3. Steels, l and r, “The Artificial Life Route To Artificial Intelligence” Building Embodied Situated Agents”, Lawrence Erlbaum, 1995.

MES008

REAL TIME OPERATING SYSTEMS

3 0 0 3

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

Course Outcomes:

After successful completion of this course, the students should be able

CO1: To understand and review about different operating system

CO2: To understand about networking and distributed operating system

CO3: To understand about real time models and languages

CO4: To understand about real time kernel

CO5: To know about various application domains in RTOS.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M			W	S				S	S
CO2		M		W	S		M		S	M		S
CO3			S		M			S	W		S	
CO4	M			M			W		M	W		S
CO5							M		S	M	S	S

UNIT – I

9

REVIEW OF OPERATING SYSTEMS

Basic Principles – System calls – Files – Processes – Design and Implementation of Processes – Communication between Processes – Operating System Structures.

UNIT – II

9

DISTRIBUTED OPERATING SYSTEMS

Topology – Network types – communication – RPC- client server model- distributed file systems- design strategies.

UNIT – III

9

REAL TIME MODELS AND LANGUAGES

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**9****REAL TIME KERNEL**

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**9****RTOS APPLICATION DOMAINS**

RTOS for image processing - Embedded RTOS for voice over IP – RTOS for voice over IP – RTOS for fault tolerant applications – RTOS for control systems.

Total Periods: 45 Hours**References**

1. Herma K, “ Real Time Systems – Design for distributed Embedded Applications “,Kluwer Academic, 1997.
2. Charles Crowley, “Operating System – A design oriented approach” McGraw Hill, 1997.
3. R.J.A Bhur, D.L. Bailey, “An introduction to Real Time Systems’, PHI 1999.
4. C.M. Krishna, Kang G Shin, “Real time systems”, McGraw Hill, 1997

MES009**ADVANCED MICROPROCESSORS****3 0 0 3****Course objectives:**

- To expose the students to the fundamentals of microprocessor architecture.
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand various microcontroller architectures.

Course outcomes:

After successful completion of this course, the students should be able to

CO1: The student will be able to work with suitable microprocessor/microcontroller for a specific real world application.

CO2: Understand the generalized architecture of advanced microprocessors and advanced microcontrollers.

CO3: Develop algorithm/program of the advanced microcontrollers for a particular task.

CO4: Interface advanced microcontrollers with external peripherals.

CO5: Students can understand the evaluation of microprocessors and microcontroller.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M	M		S					
CO2	S	M	M			S	W					

CO3				S	W		M					
CO4		S	W		M		S					
CO5	M											

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, “Microprocessors 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.
4. Intel Ciminera and Advance Voltage “Advanced Microprocessor Architecture”, Addison Wesley, USA, 1987.

MES010 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM 3 0 0 3

Course Objectives:

- AI programs that achieve expert-level competence in solving problems in task areas by bringing to bear a body of knowledge about specific tasks are called knowledge-based or expert systems.
- The term expert systems is reserved for programs whose knowledge base contains the knowledge used by human experts, in contrast to knowledge gathered from textbooks or non-experts.
- More often than not, the two terms, expert systems (ES) and knowledge-based systems (KBS), are used synonymously.
- The area of human intellectual endeavor to be captured in an expert system is called the task domain. Task refers to some goal-oriented, problem-solving activity.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: 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.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S	M				M		S		
CO2	S	M	M		S				S	W		
CO3				S	W		M	W		M		
CO4		S	W		M			M		S		
CO5	M											

UNIT-I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Overview of AI-general concepts- problem spaces and search- Search techniques –Bfs, DFS- Heuristic search techniques

UNIT-II KNOWLEDGE REPRESENTATION 9

Knowledge- general concepts – predicate logic – representing simple fact- instance and ISA relationships- Resolution – Natural deduction

UNIT-III KNOWLEDGE ORGANISATION AND MANIPULATION 9

Procedural versus Declaration knowledge – forward vs Backward reasoning- matching techniques- control knowledge/strategies – symbol reasoning under uncertainty- introduction to non –monotonic- reasoning- logic for monotonic reasoning

UNIT-IV PERCEPTRON- COMMUNICATION AND EXPERT SYSTEMS**9**

Natural language processing – pattern recognition- visual image understanding – Expert system architecture

UNIT-V KNOWLEDGE ACQUISITION**9**

Knowledge acquisition- general concepts – learning – learning by introduction- Explanation based learning

Total periods :45 Hours**Texts books:**

1. Elaine Rich and kelvin Knight, Artificial Intelligence, Tata mcgraw Hill, New Delhi
2. Stuart Russell and peter Norvig , Artificial Intelligence : A modern approach, Prentice Hall,1995

References books:

1. Nilson N. J.Principles of Artificial Intelligence ,SpringrVerlag – Bergin,1980.
2. Pattrrson, Introdution of Artificial intelligence and Expert systems prentice Hall of India, New Delhi,1990

MES011 ADVANCED DIGITAL SIGNAL PROCESSING**3 0 0 3****Objectives:**

- To learn about random signal processing
- To know about spectrum and linear estimation.
- To know about adaptive filters
- To understand the concepts related to multirate digital signal processing.
- To study about Decimation by an integer factor

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To learn about random signal processing and there algorithms

CO2: To know about spectrum and linear estimation for various methods of spectrum analyser

CO3: To know about adaptive filters linear estimation and their premitives.

CO4: To understand the concepts related to adaptive filters digital signal processing.

CO5: To understand different amplifiers in low signal.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M			W						S
CO2		M		W	S							S
CO3			S		M	M		S	M			S

CO4	M			M			S	W				
CO5						W		M	W			S

UNIT-I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes, Expectations, Variance, Co-variance, Scalar product, Energy of Discrete Signals- Parseval's Theorem, Wiener Khintchine Relation- Power Spectral Density- Periodogram- Sample Autocorrelation- Sum Decomposition Theorem, Spectral Factorization Theorem- Discrete Random Signal Processing by Linear Systems- Simulation of White Noise- Low Pass filtering of white noise.

UNIT-II SPECTRUM ESTIMATION 9

Non-Parametric Methods- Correlation Method- Co-Variance Estimator- Performance Analysis of Estimator- Barlett Spectrum Estimation- Welch Estimation- Model Based Approach- AR, MA, ARMA Signal Modeling- Parameter Estimation using Yule-Walker Method.

UNIT-III LINEAR ESTIMATION AND PREDICTION 9

Maximum likelihood criterion- efficiency of estimator- least mean squared error criterion- Wiener filter- Discrete Wiener Hoff Equation- Recursive estimators- Kalman filter- linear prediction, prediction error whitening filter, inverse filter- Levinson recursion, Lattice realization and Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT-IV ADAPTIVE FILTERS 9

FIR adaptive filters- Newton's steepest descent method- adaptive filter based on steepest descent method- Widrow Hoff LMS adaptive algorithm- Adaptive channel equalization- Adaptive echocanceller- Adaptive noise cancellation- RLS adaptive filter- Exponentially weighted RLS- Sliding window RLS- Simplified IIR LMS adaptive filter.

UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING 9

Mathematical description of sample rate- interpolation and Decimation- continuous time model direct digital approach- Decimation by an integer factor- interpolation by an integer factor- Single and multistage realization- poly phase realization- Application to Sub band coding- Wavelet transform and filter bank implementation of wavelet expansion of signals.

Total Periods :45 Hours

Textbooks:

1. Monson.H.Hayes, Statistical Digital Processing and Modelling, John Wiley and Sons.INC, New York.1996.

References:

1. Sophocles J.Orfanidis, Optimum Signal Processing, McGraw Hill.1990.
2. John.G.Proakis, Dimitris G.Manofakis.Digital Signal Processing Prentice Hall of India, 1995.

MES012 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING 3 0 0 3

Course Objectives:

- To understand the difference between the pipeline and parallel concepts.
- To study the various types of architectures and the importance of scalable architectures.
- To study the various memories and optimization of memory.
- To know about Parallel and scalable architectures
- To study about environments, UNIX, MACH and OSF/1 for parallel computers.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To understand the performances and measures for VLSI.

CO2: To understand the various types of architectures.

CO3: To study the various memories and optimization of memory.

CO4: Compare and evaluate the performance of various architectures

CO5: Analyze the requirements of large systems to select and build the right infrastructure.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M			W	S					S
CO2		M		W	M		S	M				
CO3			S			S	W					S
CO4	M			M	W		M	W				S
CO5					M		S	M				

UNIT-I THEORY OF PARALLELISM –PART-I

9

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

9

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

9

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 weak consistency model.

UNIT-IV PIPELINING AND SUPERSCALAR TECHNOLOGIES

9

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.

Total Periods: 45 Hrs

References:

1. Kai Hawang, “Advanced Computer Architecture”, McGraw Hill international, 1993.
 2. William Stallings, “Computer Organization and Architecture”, Macmillan Publishing Company, 1990.
- M.J.Quinn, “Designing Efficient Algorithms for Parallel Computer”, McGraw Hill International 1994.

MES0013 DESIGN OF SEMICONDUCTOR MEMORIES 3 0 0 3

Objectives:

- To study the architectures for SRAM and DRAM
- To know about various non-volatile memories.
- To study the fault modeling and testing of memories for fault detection.
- To learn the radiation hardening process and issues for memory.
- To know about Ferroelectric Random Access Memories (FRAMs).

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Design Memory Structures.

CO2: Decide the type of memory for a specific application.

CO3: Describe the smartness in the circuits used for memories.

CO4: Design the architectures of Static and Random Access, Nonvolatile memories.

CO5: Evaluate the fault modeling and testing procedures for memory circuit.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S		S			M		S	M	S
CO2	M		S	M	S				S	W		S
CO3		S	W		S			W		M	W	S
CO4	W		M	W	S			M		S	M	S
CO5	M		S	M	S			S	M		S	S

UNIT-I RANDOM ACCESS MEMORY TECHNOLOGY

9

Static Random Access Memories(SRAM) SRAM Cell Structure-MOS SRAM Architecture-MOS SRAM Cell and Peripherals Circuit Operation – Bipolar SRAM Technologies –Silicon On Insulator (Sol) Technology – Advanced SRAM Architecture and Technologies – Application

Specific SRAMs Dynamic Random Access Memoirs(DRAMs) DRAM Technology Development – CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures-BICMOS DRAMs – Soft Error Failure in DRAMs – Advanced DRAM Designs and Architecture – Application Specific DRAMs.

UNIT-II NON VOLATILE MEMORIES

9

Mask Read Only Memories(ROMs)-High Density ROMs-Programmable Read Only Memories(PROMs)-Bipolar PROMs CMOS PROMs-Erasable (UV) – Programmable Read Only Memories(EPROMs) - Floating – Gate EPROM Cell-One Time Programmable (OTP) EPROMs -Electrically Erasable PROMs(EEPROMs) – EEPROM Technology and Architecture – Non Volatile SRAM – Flash Memories (EPROM or EEPROM)

UNIT-III MEMORY FAULTS MODELLING, TESTING AND MEMORY DESIGN FOR TESTABILITY AND FAULT TOLERANCE

9

RAM Fault, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault modeling and Testing-Application Specific Memory Testing

UNIT-IV SEMICONDUCTOR MEMORY RELIABILITY AND RANDOM EFFECTS

9

General Reliability Issues-RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability – Reliability Modeling and Failure Rate Prediction – Design for Reliability – Reliability Test Structures – Reliability Screening and Qualification. Radiation Effects-Single Event Phenomenon (SEP) – Radiation Hardened Memory Characteristics – Radiation Hardness Assurance and Testing – Radiation Dosimetry - Water Level Radiation Testing and Test Structures.

UNIT-V ADVANCED MEMORY TECHNOLOGIES AND HIGH DENSITY MEMORY PACKAGING TECHNOLOGICS

9

Ferroelectric Random Access Memories (FRAMs) – Gallium Arsenide (GaAs) FRAM – Analog Memories Magneto Resistive Ferroelectric Random Access Memories (MRAMS) – Experimental Memory Devices Memory Hybrids and MCMs (2D – Memory Stacks and MCMs 3D) – Memory MCM Testing and Reliability Issues – Memory Cards – High Density Memory Packing Feature Directions.

Total periods: 45 Hrs

Text Books:

1. Ashok K. Sharma, “Semiconductor Memories Technology, Testing, and Reliability”, Prentice Hall of India Limited. New Delhi 1997.

MES014 VLSI ARCHITECTURE AND DESIGN METHODOLOGIES 3 0 0 3

Course Objectives:

- To give an insight to the students about the significance of CMOS technology and fabrication process.

- To teach the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction and design algorithms
- To teach the basic analog VLSI design techniques.
- To study the Logic synthesis and simulation of digital system with Verilog HDL.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To understand about the advanced topics in Boolean algebra.

CO2: To know about analog and high speed VLSI.

CO3: To know in detail about programmable ASICs and its interconnects.

CO4: To understand about programmable ASIC its logic synthesis, simulation and testing of VLSI circuits

CO5: To understand about simulation and testing of VLSI circuits

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		S	M		M		S	M		S	M
CO2		S	W		S		S	W		S	W	
CO3	W		M	W		W		M	W		M	W
CO4	M		S	M		M		S	M		S	M
CO5	S	S	S		S			S	M		S	S

UNIT-I INTRODUCTION

9

Overview of a Digital VLSI design Methodologies- Trends in IC Technology advanced Boolean algebra- Shannon's expansion theorem- consensus theorem – Octal designation-Run Measure – Buffer gates- Gate Expander- Reed Muller expansion- Synthesis of multiple output combinational logic circuits by product map method- Design of Static hazard free and dynamic hazard free logic circuits.

UNIT-II ANALOG VLSI AND HIGH SPEED VLSI

9

Introduction to analog VLSI- Realisation of Neural Networks and switched capacitors filters- sub- micron Technology and GaAs VLSI technology.

UNIT-III PROGRAMMABLE ASICS

9

Antifuse- Static RAM-EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA- Altera FLEX- Altera MAX DC & AC inputs and outputs – clocks and power inputs – Xilinx I/O blocks.

UNIT-IV PROGRAMMABLE ASIC DESIGN SOFTWARE

9

Actel ACT – Xilinx LCA- Xilinx EPLD - Altera MAX 5000 & 7000 – Altera Max 9000 – Design Systems – Logic synthesis – half gate ASIC – Schematic entry – low level design language – PLA tools – EDIF – CFI design representation.

UNIT-V LOGIC SYNTHESIS , SIMULATION AND TESTING

9

Basic features of VHDL language for behavioral modeling and simulation – Summary of VHDL data types – Dataflow and structural modeling – VHDL and logic Synthesis – types of simulation – Boundary scan Test – fault Simulation – Automatic test Pattern Generation.

Total Periods: 45 Hours

References:

1. Willam I. Fletcher “ An Engineering Approach to Digital Design” Prentice Hall of India 1996.
2. Amar Mukherjee, “Introduction to NMOS and CMOS VLSI System Design”. Prentice Hall of India 1986.
3. M.J.S. Smith “Application – Specific Integrates Circuits “, Addison Wesley Longman Inc. 1997.
4. Fedrick J. Hill and Gerald R. Peterson, “ Computer Aider Logical Design with Emphasis on VLSI

MES015

INTRODUCTION TO VLSI DESIGN

3 0 0 3

Objectives:

- To understand the concepts of MOS transistors operations and their AC , DC characteristics.
- To know the fabrication process of CMOS technology and its layout design rules.
- To know the concepts of power estimation and delay calculations in CMOS circuits.
- To learn about the VLSI circuit components and physical design.
- To study the concepts of Verilog in designing digital logic circuits.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Design layout and schematic and analysis digital logic gates

CO2: Simulate different logic gates using industry standard software CAD tools
Cadence

CO3: Explain the purpose and applications of CMOS technology

CO4: Familiar with Digital Integrated Circuits and System Building Blocks

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S		S			S	M		S	S
CO2	M		S	M		S		M		S	M	
CO3		S	W		S	W			S	W		S

CO4	W		M	W		M		W		M	W	
CO5	M		S	M		S		M		S	M	

UNIT – I MOS TECHNOLOGY AND CIRCUITS

9

MOS Technology and VLSI, Process parameters and consideration for BJT, MOS and CMOS, CMOS logic, MOS transistor theory, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage, Body effect, Design equations, Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model.

UNIT –II CMOS CIRCUITS DESIGN PROCESS

9

CMOS fabrication, P -Well process, N -Well process, twin - tub process, MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS logic structures, Transmission gates, Static CMOS design, dynamic CMOS design.

UNIT III CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION

9

Resistance estimation, Capacitance estimation, Inductance, switching characteristics, transistor sizing, power dissipation and design margining. Charge sharing. Scaling.

UNIT – IV VLSI SYSTEM COMPONENTS CIRCUITS AND SYSTEM LEVEL PHYSICAL DESIGN

9

Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits, Ripple carry adders, Carry look ahead adders, High-speed adders, Multipliers. Physical design – Delay modelling, cross talk, floor planning, power distribution. Clock distribution.

UNIT V SPECIFICATION USING VERILOG HDL

9

Basic concepts- identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow and RTL, structural gate level switch level modeling, Design hierarchies, Behavioral and RTL modeling, Test benches, Design of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop

Total Periods: 45 Hours

References:

1. Douglas A. Pucknell and Kamran Eshraghian, “Basic VLSI Design Systems and Circuits”, Prentice Hall of India Pvt. Ltd., 1995.
2. Wayne Wolf, ”Modern VLSI Design”, 2nd Edition, Prentice Hall 2002.
3. Amar Mukherjee, “Introduction to NMOS and CMOS VLSI System Design,” Prentice Hall,
4. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.

5. John P.Uyemura “Introduction to VLSI Circuits and Systems”, John Wiley &

RESEARCH METHODOLOGY

Objectives

- To Get adequate knowledge about research concepts
- To describe mathematical modeling and simulation
- To understand experimental modeling
- To get knowledge about the interpretation of result

Course Outcomes after successful completion of this course, the students should be able to

CO 1: To describe research concepts.

CO 2: To Get adequate knowledge about mathematical modeling

CO 3: To describe experimental modeling

CO 4: To understand analysis of results.

CO 5: To know about report writing

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak							
COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M				M	M
CO2	S	M				M	M
CO3	S	M				M	M
CO4	S	M				M	M
CO5	S	M				M	M

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, “Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CHOICE BASED CREDIT SYSTEM
M.TECH. VLSI DESIGN
(FULL TIME)
I – IV SEMESTERS

SEMESTER-I						
Code	Category	Subject Name	L	T	P	C
Theory						
MMA101	PM	Applied Mathematics for Electronics Engineers	3	1	0	4
MVL101	PC	Solid state device modeling and simulations	3	0	0	3
MAE102	PC	Advanced Digital System Design	3	0	0	3
MVL102	PC	Introduction to VLSI Design	3	0	0	3
MVL1E1	PE	Professional Elective-I	3	0	0	3
Practical						
MVL1L1	PC	VLSI Design lab – I	0	0	4	2
Total No. of Contact Hours: 20			Total Credits: 18			
SEMESTER-II						
Code	Category	Subject Name	L	T	P	C
Theory						
MAE201	PC	Analysis and Design of Analog Integrated circuits	3	0	0	3
MVL201	PC	Computer Aided design of VLSI Circuits	3	0	0	3
MVL202	PC	Low Power VLSI	3	0	0	3
MVL2E2	PE	Professional Elective-II	3	0	0	3
MVL2E3	PE	Professional Elective-III	3	0	0	3
Practical						
MVL2L2	PC	VLSI Design Lab –II	0	0	4	2
Total No. of Contact Hours: 20			Total Credits: 17			
SEMESTER-III						

Code	Category	Subject Name	L	T	P	C
Theory						
MVL3E3	PE	Professional Elective-IV	3	0	0	3
MVL3E4	PE	Professional Elective-V	3	0	0	3
MVL3E5	OE	Open Elective - I	3	0	0	3
MVL3P1	PR	Project work phase-I	0	0	12	6
Total No. of Contact Hours: 21			Total Credits:15			

SEMESTER-IV						
Code	Category	Subject Name	L	T	P	C
MVL4P2	PR	Project work phase-II	0	0	24	12
Total No. of Contact Hours: 24			Total Credits: 12			

OVERALL CREDIT FOR THE PROGRAMME - 62

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – I(PE-I)

Code No.	Course Title	L	T	P	C
MVL001	CMOS VLSI DESIGN	3	0	0	3
MVL002	VLSI SIGNAL PROCESSING	3	0	0	3
MVL003	ANALOG VLSI DESIGN	3	0	0	3

PROFESSIONAL ELECTIVE – II(PE-II)

Code No.	Course Title	L	T	P	C
MVL004	SYSTEM ON CHIP DESIGN	3	0	0	3
MVL005	DESIGN OF SEMICONDUCTOR MEMORIES	3	0	0	3
MVL006	VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	3	0	0	3

PROFESSIONAL ELECTIVE – III(PE-III)

Code No.	Course Title	L	T	P	C
MVL007	SUBMICRON VLSI DESIGN	3	0	0	3
MVL008	TESTING OF VLSI CIRCUITS	3	0	0	3
MVL009	NANOSCALE DEVICES AND CIRCUIT	3	0	0	3

PROFESSIONAL ELECTIVE – IV(PE-IV)

Code No.	Course Title	L	T	P	C
MVL014	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3
MVL013	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN	3	0	0	3
MVL010	OPTIMIZATION TECHNIQUES IN VLSI DESIGN	3	0	0	3

PROFESSIONAL ELECTIVE – V(PE-V)

Code No.	Course Title	L	T	P	C
MVL011	VLSI for Wireless Communication	3	0	0	3
MVL012	Computer Architecture and Parallel Processing	3	0	0	3
MVL015	Real Time Operating System	3	0	0	3

OPEN ELECTIVE – I(OE-I)

Code No.	Course Title	L	T	P	C
MED102	EMBEDDED SYSTEMS	3	0	0	3
MED201	ASIC DESIGN	3	0	0	3
MST070	RESEARCH METHODOLOGY	3	0	0	3

**SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT
HOUR DISTRIBUTION**

S. No.	Sub Area	Credit AS per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics (PM)	4				4	6.06
2	Professional Core (PC)	11	11			24	36.36
3	Professional Electives (PE)	3	6	6		15	22.72
4	Open Electives (OE)			3		3	4.54
5	Project Work, Seminar, Internship, Term Paper, etc. (PR)			6	12	20	30.30
6	Total Credit	18	17	15	12	62	100
7	Total Contact Hour	20	20	21	24	85 Hrs	-

Course Code MMA101	Course Name: Applied Mathematics for Electronic Engineers		L	T	P	C
	Total Contact Hours:60		3	1	0	4
	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.						
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.					
Mapping of Course Outcomes with 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				
	CO2		M			M
	CO3	H				
	CO4			M		
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

REFERENCE 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 Code MVL101	Course Name: SOLID STATE DEVICE MODELING AND SIMULATIONS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Engineering Physics				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES					
To apply all taught techniques to learn the modeling of bipolar devices and to understand about the modeling of MOSFET and to learn about the circuit simulators.					
COURSE OUTCOMES (COs)					
CO1	To Understand the complicated device models that are widely used in VLSI tools.				
CO2	To Understand the changes introduced in the device models as well as contribute to the development of appropriate device models				
CO3	To Understand the complicated MOSFET Modeling.				
CO4	To Understand the complicated device models that is widely used in CAD tools.				
CO5	To Understand the changes introduced in the device models as well as contribute				

		to the development of appropriate EKV models				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	E
2	CO1	H				
	CO2			L		L
	CO3		M			
	CO4	H			M	
	CO5		M			M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I BASIC SEMICONDUCTOR PHYSICS

7

Quantum Mechanical Concepts, Carrier Concentration, Transport Equation Bandgap, Mobility and Resistivity, Carrier Generation and Recombination Avalanche Process, Noise Sources.

UNIT II MODELING BIPOLAR DEVICE PHENOMENA

10

Injection and Transport Model, Continuity Equation, Diode Small Signal and Large Signal (Charge Control Model), Transistor Models: Eberly – Moll and Gummel Poon Model, Mextram Model, Spice Modeling Temperature and Area Effects.

UNIT III MOSFET MODELING

10

Introduction Inversion Layer, MOS Transistor Current, Threshold Voltage, Temperature Short Channel and Narrow Width Effect, Models for Enhancement, Depletion Type MOSFET, CMOS Models in SPICE.

UNIT IV PARAMETER MEASUREMENT

10

General Methods, Specific Bipolar Measurement, Depletion Capacitance, Series Resistances, Early Effect, Gummel Plots, MOSFET: Long and Short Channel Parameters, Statistical Modeling of Bipolar and MOS Transistor.

UNIT V OTHER MOSFET MODELS

The EKV model, model features, long channel drain current model, modeling second order effects of the drain current, modeling of charge storage effects, Non-quasi-static modeling, Noise model, temperature effects, MOS model 9, MOSAI model, PSP model, Influence of process variation, Modeling of device mismatch for Analog/RF Applications.

TEXT BOOKS:

1. Philip E. Allen, Douglas R.Hoberg. “CMOS Analog Circuit Design” Second Edition, Oxford Press-2002 (Unit III)
2. CMOS/BICMOS CLSI Low Voltage Power Kiat Seng Yeo, Samir S Rofail, Wang-Ling Gob, Person Education low price edition– 2002 (Unit IV)

REFERENCES BOOK:

1. S.M. Sze “Semiconductor Devices – Physics and Technology”. John Wiley and Sons 1985 (Unit 1, Unit II)
2. Giuseppe Massobrio and Paolo Antognetti, “Semiconductor Device Modeling with SPICE “Second Edition, McGraw-Hill Inc, New York. 1993 (Unit I, Unit II and Unit III).
3. Mohammed Ismail & Tern Fiez “Analog VLSI – Signal & Information Processing”, (Statistical Modeling of Mosfet unit IV).

Course Code MAE102	Course Name: Advanced digital system design		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Digital communication					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES To learn the concepts of theorems and other techniques to design minimized logic functions and To Understand the concepts of synchronous and asynchronous sequential circuit design and						
COURSE OUTCOMES (COs)						
CO1	Ability to analyze and design sequential digital circuits					
CO2	Ability to understand the requirements and specifications of the system required for a given application					
CO3	Ability to understand programmable logic devices					
CO4	To learn about the faults in logic circuits and metods of diagnosing it					
CO5	To learn about programmable logic 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
2	CO1		M			
	CO2	H				L
	CO3	H			M	
	CO4		M			M
	CO5			L		

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

UNIT I ADVANCED TOPICS IN BOOLEAN ALGEBRA

9

Shannon's expansion theorem, Consensus theorem, Octal designation, Run measure, INHIBIT/INCLUSION/AOI/Driver /Buffer gates ,Gate expander, Reed Muller expansion, Synthesis of multiple output combinational logic circuits by product map method ,Design of static hazard free and dynamic hazard free logic circuits.

UNIT II SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

9

Analysis of clocked synchronous sequential Networks (CSSN), Modeling of CSSN, State table assignment and reduction, Design of CSSN, Design of iterative circuit, ASM Chart, ASM Realization. Design of Arithmetic circuits for Fast adder, Array Multiplier.

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

9

Analysis of Asynchronous Sequential Circuit (ASC) ,Flow Table Reduction , Races in ASC , State Assignment Problem and the Transition Table, Design of ASC ,Data Synchronizers, Designing vending Machine Controller, Mixed Operating Mode Asynchronous Circuits.

UNIT IV FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

9

Fault Table Method ,Path Sensitization Method, Boolean Difference Method, Kohavi Algorithm, Tolerance Techniques , The Compact Algorithm, Practical PLA's, Fault in PLA Circuit Test Approach, Transition Check Approach , State identification and fault detection experiment .

UNIT-V PROGRAMMABLE LOGIC DEVICES

9

Basic concepts, Programming technologies, Programmable Logic element (PLE), Programmable Logic Array (PLA), System Design using PLD's - Design of combinational and sequential circuits using PLD's (CPLD). Programming PAL device using PALSAM , Design of state machine using Algorithmic State Machines (ASM) chart as a design tool, Introduction to Field Programmable Gate Arrays – Types of FPGA, Xilinx XC 3000 series, Logic Cell Array (LCA), Configurable Logic Blocks (CLB) INPUT/OUTPUT Block (IPB) - Programmable Interconnect Point (PIP), Introduction to Actel AACT2 FAMILY AND XILINX XC 4000 families , Design examples.

TEXT BOOK:

1. William I.Fletcher, “An Engineering Approach to Digital Design”, PrenticeHall of India.
2. Switching and Finite Automata Theory – Z. Kohavi , 2nd Ed., 2001, TMH
3. Digital Design – Morris Mano, M.D.Ciletti, 4th Edition, PHI.
4. Digital Circuits and Logic Design – Samuel C. Lee , PHI

REFERENCES BOOK:

1. Donald G. Givone, “Digital principles and Design”, Tata McGraw Hill 2002.
2. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003.
3. John M Yarbrough, “Digital Logic applications and Design”, Thomson Learning, 2001.
4. Nripendra N Biswas, “Logic Design Theory”, Prentice Hall of India, 2001.
5. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.

Course Code MVL102	Course Name: INTRODUCTION TO VLSI DESIGN		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					
OBJECTIVES						
To understand the concepts of MOS transistors operations and their AC , DC Characteristics and To know the fabrication process of CMOS technology and its layout design rules and To know the concepts of power estimation and delay calculations in cmos circuits						
COURSE OUTCOMES (COs)						
CO1	To learn the basic MOS and CMOS circuit, characteristics and performance.					
CO2	To learn the circuit components at physical level design.					
CO3	To learn the different abstract levels in Verilog for modeling digital circuits.					
CO4	To learn about the VLSI circuit components and physical design					
CO5	To study the concepts of Verilog in designing digital logic 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
2	CO1		H		M	
	CO2	L				L
	CO3			L		
	CO4		M			M
	CO5		H		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

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

UNIT – I MOS TECHNOLOGY AND CIRCUITS

9

MOS Technology and VLSI, Process parameters and consideration for BJT, MOS and CMOS, CMOS logic, MOS transistor theory, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage, Body effect, Design equations, Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model

UNIT –II CMOS CIRCUITS DESIGN PROCESS

9

CMOS fabrication, P -Well process, N -Well process, twin - tub process, MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS logic structures, Transmission gates, Static CMOS design, dynamic CMOS design.

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION

9

Resistance estimation, Capacitance estimation, Inductance, switching characteristics, transistor sizing, power dissipation and design margining. Charge sharing .Scaling.

UNIT – IV VLSI SYSTEM COMPONENTS CIRCUITS AND SYSTEM LEVEL PHYSICAL DESIGN

9

Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits, Ripple carry adders, Carry look ahead adders, High-speed adders, Multipliers. Physical design – Delay modelling, cross talk, floor planning, power distribution, Clock distribution.

UNIT V SPECIFICATION USING VERILOG HDL

9

Basic concepts- identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow and RTL, structural gate level switch level modeling, Design hierarchies, Behavioral and RTL modeling, Test benches, Design of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop

TEXT BOOK:

1. Douglas A. Pucknell and Kamran Eshraghian, “Basic VLSI Design Systems and Circuits”, Prentice Hall of India Pvt. Ltd., 1993.
2. Wayne Wolf, ”Modern VLSI Design”, 2nd Edition, Prentice Hall 1998.
3. Amar Mukherjee, “Introduction to NMOS and CMOS VLSI System Design,” Prentice Hall,

REFERENCES BOOK:

1. John P.Uyemura “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc., 2002..
2. Fabricious E. “Introduction to VLSI Design”, McGraw Hill, 1990.
3. J.Bhasker: Verilog HDL primer, BS publication, 2001
4. Ciletti Advanced Digital Design with the Verilog HDL, Prentice Hall of India, 2003

Course Code MVLIL1	Course Name: VLSI DESIGN LAB I		L	T	P	C
	Total Contact Hours: 45		0	0	4	2
	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						
COURSE OUTCOMES (COs)						
CO1	To learn about the design of digital circuits of HALF ADDER, FULL ADDER Hardware description languages					
CO2	To learn about the design of digital circuits of HALF SRACTOR/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 description languages					
CO5	To learn about the design of digital circuits of JK, D, T, SR FLIPFLOPS					
Mapping of Course Outcomes with 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		L
	CO2	M	H			
	CO3			M		M
	CO4		H		M	
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

(ALL SHOULD BE DONE USING VERILOG HDL & VHDL CODE ON FPGA)

- DESIGN AND TESTING OF HALF ADDER, FULL ADDER.
- 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.

Students will be able to design and implement digital logic circuits on FPGA

SEMESTER II

Course Code MAE201	Course Name: Analysis and design of L T P C analog integrated circuits					
	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 analyse high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers						
COURSE OUTCOMES (COs)						
CO1	Ability to analyse 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.					
Mapping of Course Outcomes with 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			
	CO2		M			L
	CO3	H				
	CO4		M		M	

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

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. Kenneth R.Laker, Willy M.C.Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems ", McGraw Hill, 1994.
2. Behzad Razavi, "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, Broderon, "Analog MOS Integrated Circuits", IEEE Press 1989.

Course Code MVL201	Course Name: COMPUTER AIDED DESIGN OF VLSI CIRCUITS	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				
OBJECTIVES						
To study various physical design methods in VLSI and To understand the concepts behind the VLSI design rules and routing techniques						
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					
Mapping of Course Outcomes with 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			
	CO2			M		L
	CO3		H			
	CO4	L				
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I INTRODUCTION 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.A Sherwani, “Algorithms for VLSI Physical Design Automation”, 1999.

REFERENCES BOOK:

1. S.H. Gerez, “Algorithms for VLSI Design Automation”, 1998.

Course Code MVL202	Course Name: 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 and						
COURSE OUTCOMES (COs)						
CO1	To know the basics and advanced techniques in low power					
CO2	To design as reduction of power is much needed to enhance the performance of the system					
CO3	To study the design concepts of High power circuits.					
CO4	To understand the various power reduction techniques and the power estimation					
CO5	To study the design concepts of low power 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
2	CO1		M			
	CO2		H			L
	CO3	L				
	CO4			M		M

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

UNIT I INTRODUCTION

9

Introduction – Simulation – Power Analysis – Probabilistic Power Analysis.

UNIT II ARCHITECTURE

9

Circuit – Logic – Special Techniques – Architecture and Systems.

UNIT III ADVANCED TECHNIQUES

9

Advanced Techniques – Low Power CMOS VLSI Design – Physical of Power Dissipation in CMOS FET Devices.

UNIT IV POWER ESTIMATION

9

Power Estimation – Synthesis for Low Power – Design and Test of Low Voltages – CMOS Circuits.

UNIT V LOW POWER ESTIMATION

9

Low Power Static RAM Architectures – Low Energy Computing Using Energy Recovery Techniques – Software Design for Low Power.

Text Books:

1. Gary Yeap “Practical Low Power Digital VLSI Design”, 1997.

References:

1. Kaushik’Roy, Sharat Prasad, “Low Power VLSI Circuit Design” 2000.

Course Code MVL2L2	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: Physical design of CMOS logic can be known and SPICE simulation of analog circuits wii be carried out to measure its related parameters.					

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					
Mapping of Course Outcomes with 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			
	CO2		M			
	CO3	L	H			L
	CO4			H	L	
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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

LIST OF ELECTIVES

Course Code MVL001	Course Name: CMOS VLSI DESIGN		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Basic CMOS VLSI Design					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES To understand about the basic concepts of CMOS logic and To learn about the performance estimation of CMOS logic and To understand about the design strategies and CMOS subsystem design.						
COURSE OUTCOMES (COs)						
CO1	To understand about the basics of CMOS technology and its performance estimation.					
CO2	To understand about the design strategies and CMOS design.					
CO3	To understand about the basic concepts of CMOS logic					
CO4	To learn about the performance estimation of CMOS logic					
CO5	To learn about the design strategies used in Digital CMOS VLSI subsystem.					
Mapping of Course Outcomes with 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			
	CO2	L				L
	CO3		H			
	CO4			M		
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION TO CMOS CIRCUITS

9

MOS Transistors, MOS Transistors switches, CMCS logic circuit and System representations, MOS Transistor theory – Introduction MOS device design equation, the

complementary CMOS inverter – DC characteristics, Static Load MOS inverters, The differential inverter, The transmission gate, The Tri state inverter, Bipolar Devices.

UNIT II CIRCUIT CHARACTERISATION AND PERFORMANCE

ESTIMATION

9

Introduction, Resistance estimation, Capacitance estimation, Inductance estimation, Switching characteristics of CMOS gate Transistor, Sizing, Power Dissipation, Sizing Routing conductors, Charge sharing, Design Margining, Reliability.

UNIT III CMOS CIRCUIT AND LOGIC DESIGN

9

CMOS Logic Gate design, Basic Physical Design of simple gate, CMOS Logic structures clocking strategies, i/o Structures, Low Power Design.

UNIT IV SYSTEMS DESIGN AND DESIGN METHOD

9

Design Strategies CMOS chip Design options, Design Methods, Design Capture Tools, Design Verification Tools, Design Economics, and Data Sheets. CMOS Testing – Manufacturing Test Principles, Design Strategies for Test, Chip level Test Techniques, System Level Test Techniques, and Layout Design for Improved Testability.

UNIT V CMOS SUB SYSTEM DESIGN

9

Data path operations – Additions/Subtraction party generators, Comparators. Zero/one Detectors, Binary Counters, ALU's, Multiplication shifters, Memory Elements, Control-FSM, Control Logic Implementation.

TEXT BOOK:

1. Nell H E Weste and Kamran Eshraghian, "Principles Of CMOS VLSI Design", 2nd Edition, Addison Westley, 1998.

REFERENCES BOOK:

1. Jaycob Backer, Harry W L and David E Byce, "CMOS Circuit Design, Layout and Simulation", PHI, 1998.

Course Code MVL 002	Course Name: VLSI 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					
To understand the various VLSI architectures for digital signal processing and To know the techniques of critical path and algorithmic strength reduction in the filter structures and To study the performance parameters, viz. area, speed and power.					
COURSE OUTCOMES (COs)					
CO1	Ability to modify the existing or new DSP architectures suitable for VLSI				
CO2	To know the techniques and algorithmic strength reduction in the filter structures				
CO3	To understand the various VLSI architectures for digital signal processing				
CO4	To study the performance parameters area.				
CO5	To study the performance parameters speed and power				

Mapping of Course Outcomes with 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			
	CO2			M		M
	CO3		H			
	CO4	L			M	
	CO5		H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS 9

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II RETIMING, ALGORITHMIC STRENGTH REDUCTION 9

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT III FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS 9

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV BIT-LEVEL ARITHMETIC ARCHITECTURES

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon’s bit-serial multipliers using Horner’s rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner’s rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters

UNIT V NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING 9

Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

TEXT BOOKS:

1. Keshab K. Parthi, “VLSI Digital Signal Processing Systems”, Design and implementation, Wiley, Inter Science, 1999.
2. S.Y. Kung, H.J. White House, T.Kailath, “VLSI and Modern Signal Processing”, Prentice Hall, 1985.

REFERENCE BOOK:

1. Jose E. France, Yannis Tsividis, “Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing”, Prentice Hall, 1994.

Course Code MVL003	Course Name:	ANALOG VLSI DESIGN	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					
OBJECTIVES To study the concepts of CMOS and BICMOS analog circuits and To understand the concepts of A/Dconvertors and analog integrated sensors and To understand the testing concepts in analog vlsi circuits and its statistical modelling.						
COURSE OUTCOMES (COs)						
CO1	To Understand that analog circuits are essential in interfacing and building amplifiers and low p filters.					
CO2	To understand the concepts of A/D convertors and analog integrated sensors					
CO3	To understand the concepts of CMOS and BICMOS analog circuits					
CO4	To understand the testing concepts in analog vlsi circuits.					
CO5	To understand the testing concepts in statistical 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
2	CO1		H			

	CO2		H			
	CO3	L		M		M
	CO4		M		M	
	CO5	M		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I BASIC CMOS CIRCUIT TECHNIQUES, CONTINUOUS TIME AND LOW VOLTAGE SIGNAL PROCESSING

9

Mixed-Signal VLSI Chips-Basic CMOS Circuits-Basic Gain Stage-Gain Boosting Techniques –Super MOS Transistor-Primitive Analog Cells-Linear Voltage-Current converters-MOS Multipliers and Resistors-CMOS, Bipolar and Low BiCMOS Op-Amp Design-Instrumentation Amplifier Design-Low Voltage Filters.

UNIT-II BASIC BICMOS CIRCUIT TECHNIQUES, CURRENT-MODE SIGNAL MESSING AND NEURAL INFORMATION PROCESSING

9

Continuous-Time Signal Processing-Sampled-Data Signal Processing-artiched-current Data Converters-Practical Consideration in SI Circuits Logically-Inspired Neural Networks-Floating-Gate,Low-Power Neural Networks-CMOS Technology and Models-Design Methodology-Networks-contrast Sensitive Silicon Retina

UNIT III SAMPALED-DATA ANALOG FILTERS,OVER SAMPLED A/D CONVERTERS AND ANALOG INTERGRATED SENSORS

9

First-order and second SC Circuits-Bilinear transformation-Cascade Design-Switched-Capacitor Ladder-Synthesis of Switched –Current filter-Nyquist rate A/D converters-Modulators for over Sampled A/D conversion- First and second Order and Multibit Sigma-Delta Modulators-interpolative Modulators-Cascade Architecture-Decimation Filters-Mechanical, Thermal, Humidity and Magnetic Sensors-Sensor interfaces.

UNIT IV DESIGN FOR TESTABLITY AND ANALOG VLSI INTERCONECTORS

9

Faults modeling and Simulation- Testability-Analysis Technique-AdHoc Methods and General Guidelines Scan Techniques-Boundary Scan-Built-in self Test- Analog Test Buses-Design for Election-Beam Testability-Physics of Interconnects in VLSI- Scaling of Interconnects-A Model for Estimating Wiring Density-A Configurable Architecture for Prototyping analog Circuits.

UNIT V STATISTICAL MODELLING AND SIMULATION, ANALOG COMPUTER-AIDED DESIGN AND ANALOG AND MIXED ANALOG-DIGITAL LAYOUT **9**

Review of statistical concepts- statistical Device Modeling-Statistical Circuit Simulation-Automation Analog Circuit Design-Automatic Analog Layout-CMOS Transistor layout-Resistor Layout-Capacitor Layout-Analog Cell Layout-Mixed Analog-Digital Layout.

TEXT BOOKS:

1. "Analog VLSI Signal and information Processing", Mohammed Ismail, Terri Fiez, McGraw-Hill International Editions, 1994.

REFERENCE BOOK:

1. Malcom R. Haskard, Lan C. May, "Analog VLSI Design- NMOS and CMOS", Prentice hall, 1998.
2. Randall I. Geiger, Phillip & Allen, Neol K. Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Company, 1990
3. Jose E. France, Yannis Tsividis, "Design of Analog-Digital VLSI Circuits for Telecommunications and Signal Processing," Prentice Hall, 1994

Course Code MVL004	Course Name: SYSTEM ON CHIP DESIGN				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Digital VLSI Design							
	Course Designed by : Dept. of Electronics And Communication Engineering							
OBJECTIVES								
To learn System on chip fundamentals, their applications and to gain knowledge on NOC design and to l the various Computation models of SOCs.								
COURSE OUTCOMES (COs)								
CO1	To understand about IP cores and application specific design							
CO2	To Understand About System Design With Model Of Computation And Co-Design							
CO3	To learn the Computation–Communication Partitioning And Network On Chip-Based Soc							
CO4	To gain knowledge on NOC design							
CO5	To learn the various Computation models of SOCs.							
Mapping of Course Outcomes with 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			M				
	CO2		H		L			
	CO3		H					
	CO4	L		M		M		
	CO5							

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

UNIT I INTRODUCTION

9

Introduction to SoC Design., Platform-Based SoC Design., Multiprocessor SoC and Network on Chip, Low-Power SoC Design

UNIT II SYSTEM DESIGN WITH MODEL OF COMPUTATION AND CO-DESIGN

9

System Models, Validation and Verification, Hardware/Software Codesign Application Analysis, Synthesis.

UNIT III COMPUTATION–COMMUNICATION PARTITIONING AND NETWORK ON CHIP-BASED SOC

9

Communication System: Current Trend, Separation of Communication and Computation. Communication-Centric SoC Design, Communication Synthesis, Network-Based Design, Network on Chip, Architecture of NoC

UNIT IV NOC DESIGN

9 Practical Design of NoC, NoC Topology-Analysis Methodology, Energy Exploration, NoC Protocol Design, Low-Power Design for NoC: Low-Power Signaling, On-Chip Serialization, Low-Power Clocking, Low-Power Channel Coding, Low-Power Switch, Low-Power Network on Chip Protocol

UNIT V NOC /SOC CASE STUDIES

9 Real Chip Implementation-BONE Series-,BONE 1-4, Industrial Implementations-,Intel's Tera-FLOP 80-Core NoC, Intel's Scalable Communication Architecture, Academic Implementations-FAUST, RAW;design case study of SoC –digital camera

TEXT BOOK:

1. Hoi-jun yoo, Kangmin Lee, Jun Kyoung kim, “*Low power NoC for high performance SoC desing*”,CRC press, 2008.

REFERENCES BOOK:

1. Vijay K. Madiseti Chonlameth Arpikanondt, “*A Platform-Centric Approach to System-on-Chip (SOC) Design*”, Springer, 2005.

Course Code MVL005	Course Name: DESIGN OF SEMI CONDUCTOR 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							
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.								
COURSE OUTCOMES (COs)								
CO1	To know the design of MOS memories and the various precautionary methods to be 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.							
Mapping of Course Outcomes with 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					
	CO2		H			L		
	CO3	L			L			
	CO4		M					
	CO5			M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

RANDOM ACCESS MEMORY TECHNOLOGY

Static Random Access Memories(SRAM) SRAM Cell Structure-MOS SRAM Architecture-MOS SRAM Cell and Peripherals Circuit Operation – Bipolar SRAM Technologies –Silicon On Insulator (Sol) Technology – Advanced SRAM Architecture and Technologies – Application Specific SRAMs Dynamic Random Access Memoirs(DRAMs) DRAM Technology Development – CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures-BICMOS DRAMs – Soft Error Failure in DRAMs – Advanced DRAM Designs and Architecture – Application Specific DRAMs.

UNIT II NON VOLATILE MEMORIES

9

Mask Read Only Memories(ROMs)-High Density ROMs-Programmable Read Only Memories(PROMs)-Bipolar PROMs CMOS PROMs-Erasable (UV) – Programmable Read Only Memories(EPROMs) - Floating – Gate EPROM Cell-One Time Programmable (OTP) EPROMs -Electrically Erasable PROMs(EEPROMs) – EEPROM Technology and Architecture – Non Volatile SRAM – Flash Memories (EPROM or EEPROM)

UNIT III MEMORY FAULTS MODELLING, TESTING AND MEMORY DESIGN FOR TESTABILITY AND FAULT TOLERANCE

9 RAM

Fault, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault modeling and Testing-Application Specific Memory Testing

UNIT IV SEMICONDUCTOR MEMORY RELIABILITY AND RANDOM EFFECTS

9

General Reliability Issues-RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability – Reliability Modeling and Failure Rate Prediction – Design for Reliability – Reliability Test Structures – Reliability Screening and Qualification. Radiation Effects-Single Event Phenomenon (SEP) – Radiation Hardened Memory Characteristics – Radiation Hardness Assurance and Testing – Radiation Dosimetry - Water Level Radiation Testing and Test Structures.

UNIT V ADVANCED MEMORY TECHNOLOGIES AND HIGH DENSITY MEMORY PACKAGING TECHNOLOGICS

9

Ferroelectric Random Access Memories (FRAMs) – Gallium Arsenide (GaAs) FRAM – Analog Memories Magneto Resistive Ferroelectric Random Access Memories (MRAMS) – Experimental Memory Devices Memory Hybrids and MCMs (2D – Memory Stacks and MCMs 3D) – Memory MCM Testing and Reliability Issues – Memory Cards – High Density Memory Packing Feature Directions.

TEXT BOOKS:

1.Ashok K. Sharma, “Semiconductor Memories Technology, Testing, and Reliability”, Prentice Hall of India Limited. New Delhi 1997.

REFERENCES BOOK:

1. Gray and Meyer, “Analysis and Design of Analog IC’s, Wiley International, 1996.

Course Code MVL006	Course Name: VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	L	T	P	C

		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Computer Design Methodologies						
		Course Designed by : Dept. of Electronics And Communication Engineering						
OBJECTIVES								
To understand about the advanced topics in Boolean algebra and To know about analog and high speed VLSI and To know in detail about programmable ASICs and its interconnects and To understand about simulation and testing of VLSI circuits.								
COURSE OUTCOMES (COs)								
CO1		To understand about programmable ASIC its logic synthesis, simulation and testing of VLSI circuits						
CO2		To know in detail about programmable ASICs and its interconnects						
CO3		To know about analog and high speed VLSI						
CO4		To understand about Programmable Asic Design Software						
CO5		To understand about simulation and testing of VLSI 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		
2	CO1		H					
	CO2	L		M				
	CO3				L			
	CO4		H			L		
	CO5		M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT – I INTRODUCTION

9

Overview of a Digital VLSI design Methodologies- Trends in IC Technology advanced Boolean algebra- Shannon's expansion theorem- consensus theorem – Octal designation-Run Measure – Buffer gates- Gate Expander- Reed Muller expansion- Synthesis of multiple output combinational logic circuits by product map method- Design of Static hazard free and dynamic hazard free logic circuits.

UNIT – II ANALOG VLSI AND HIGH SPEED VLSI

9

Introduction to analog VLSI- Realisation of Neural Networks and switched capacitors filters- sub- micron Technology and GaAS VLSI technology.

UNIT – III PROGRAMMABLE ASICS

9

Antifuse- Static RAM-EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA- Altera FLEX- Altera MAX DC & AC inputs and outputs – clocks and power inputs – Xilinx I/O blocks.

UNIT – IV PROGRAMMABLE ASIC DESIGN SOFTWARE

9

Actel ACT – Xilinx LCA- Xilinx EPLD - Altera MAX 5000 & 7000 – Altera Max 9000 – Design Systems – Logic synthesis – half gate ASIC – Schematic entry – low level design language – PLA tools – EDIF – CFI design representation.

UNIT – V LOGIC SYNTHESIS , SIMULATION AND TESTING

Basic features of VHDL language for behavioral modeling and simulation – Summary of VHDL data types – Dataflow and structural modeling – VHDL and logic Synthesis – types of simulation – Boundary scan Test – fault Simulation – Automatic test Pattern Generation.

TEXTBOOK:

1. Willam I. Fletcher “ An Engineering Approach to Digital Design” Prentice Hall of India 1996.
2. Amar Mukherjee, Introduction to NMOS and CMOS VLSI System Design. Prentice Hall of India 1986

REFERENCES BOOK:

- 1.M.J.S. Smith “ Application – Specific Integrates Circuits “, Addison Wesley Longman Inc. 1997.
- 2.Fedrick J. Hill and Gerald R. Peterson. “ Computer Aider Logical Design with emphasis on VLSI”.

Course Code MVL007	Course Name: SUBMICRON 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 introduce the Concepts of silicon realization of ASIC and Cmos devices at deep Submicron Level and To study and apply the deep Submicron concepts to Cmos low power devices and To study and discuss about Rf Cmos transistor sizing and its limitations.					
COURSE OUTCOMES (COs)					
CO1	To understand about the design constraints for CMOS devices at deep submicron level for low power				
CO2	To understand about the reliability constraints while designing CMOS devices at submicron level.				
CO3	To understand about the design constraints for CMOS devices at deep submicron level high speed				
CO4	To study and apply the deep Submicron concepts to Cmos low power devices				
CO5	To study and discuss about RF CMOS transistor sizing and its limitations.				

Mapping of Course Outcomes with 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		M			
	CO2		H		M	L
	CO3	M		L		
	CO4		H			M
	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I SILICON REALIZATION OF ASIC

9

Introduction-Handcrafted layout implementation-bit-slice layout implementation-Cell based layout implementation- gate array layout implementation-Hierarchical design approach- The choice of layout implementation form

UNIT II LOW POWER DESIGN

9

-Sources of CMOS power consumption-technology options for low power-reduction of P-leak by technological measures Reduction of P-dyn by technology measures-reduction of P-dyn by reduced voltage process-design option for low power-computing power vs chip power-a scaling perspectives.

UNIT III DESIGN FOR RELIABILITY

9

Introduction-latch up in CMOS circuits-Electrostatics discharge-and its protection-Electro migration-Hot carrier degradation design for signal integrity-clock distribution and critical timing issues-clock generation and synchronization in different domain on a chip-the influence of interconnection-design organization

UNIT IV DEEP SUB MICRON

9

-RF CMOS Transistor downsizing limitations-. RF basic blocks layout implementation Submicron technology and layout dependent effects-input output interfacing, the bonding pad, the pad ring, electrostatic discharge prevention.

UNIT V CMOS DEVICES

9

Clamp CMOS devices, zener diode-input structure-output structure-pull up-pull down-i/o pad,power clamp-core/pad limitation I/O Pad description using Ibis-Connecting to the package-Signal propagation between integrated circuits

TEXTBOOK:

1. Deep-Submicron Cmos Ics: From Basics to Asics By Harry J. M. Veendrick
2. Low Power Design in Deep Submicron Electronics by W. Nebel, Jean P. Mermet

REFERENCES BOOK: -

1. Low-Power Deep Sub-Micron CMOS Logic: Sub-threshold Current Reduction by P.R.Van Der Meer, Arie van Staveren, Arthur H. M. van Roermund

Course Code MVL008	Course Name: TESTING OF VLSI CIRCUITS		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: VLSI Testing					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES						
To know the various types of faults and also to study about fault detection, dominance and To know the concepts of the test generation methods-DFT-BIST. To understand the fault diagnosis methods.						
COURSE OUTCOMES (COs)						
CO1	To familiarize with the principles used in the construction VLSI Design For Test (DFT) tools.					
CO2	To develop more efficient tools from the fault coverage and speed point of view.					
CO3	To study about fault detection and dominance					
CO4	To know the concepts of the test generation methods-DFT-BIST.					
CO5	To understand the fault diagnosis 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			
	CO2		M			
	CO3		M		M	
	CO4		H			M
	CO5	M		L		

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

UNIT I TESTING AND FAULT MODELLING

9

Introduction to testing – Faults in Digital Circuits – Modelling of faults – Logical Fault Models– Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation – Delay models – Gate Level Event – driven simulation

UNIT II TEST GENERATION

9

Test generation for combinational logic circuits – Testable combinational logic circuit design– Test generation for sequential circuits – design of testable sequential circuits.

UNIT III DESIGN FOR TESTABILITY

9

Design for Testability – Ad-hoc design – generic scan based design – classical scan based design – system level DFT approaches.

UNIT IV SELF – TEST AND TEST ALGORITHMS

9

Built-In self Test – test pattern generation for BIST – Circular BIST – BIST Architectures – Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs.

UNIT V FAULT DIAGNOSIS

9

Logical Level Diagnosis – Diagnosis by UUT reduction – Fault Diagnosis for Combinational Circuits – Self-checking design – System Level Diagnosis.

TEXT BOOK:

1. Viswani D. Agarwal, Michael L. Bushnell, “Essential of Electronic Testing for Digital Memory & Mixed Signal VLSI Circuit”. Kulwer Academic Publications, 1999.
2. Alfred L. Crouch “Design for Test for Digital IC’s and Embedded Core Systems”. – PHI 1999.
3. M.Abramovici, M.A.Breuer and A.D. Friedman, “Digital systems and Testable Design”, Jaico Publishing House,2002.

REFERENCES BOOK:

1. P.K. Lala, “Digital Circuit Testing and Testability”, Academic Press, 2002.
2. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002.

Course Code MVL009	Course Name: NANOSCALE DEVICES AND CIRCUIT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Nano Techonology				
		Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES						
To learn about leakage current and its control and reduction techniques in CMOS devices and To know the device technologies for sub 100nm CMOS and To study the device scaling of single and multigate MOSFETs						
COURSE OUTCOMES (COs)						
CO1	To understand about the concepts of nanoscale devices which in turn can be used for high speed VLSI circuits.					
CO2	To study the device scaling of single and multigate MOSFETs					
CO3	To familiarize the low power design and voltage scaling issues in Nano scale devices					
CO4	To study about various nanoscale devices					
CO5	To design CMOS circuit using non-classical 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
2	CO1			M		
	CO2		H			
	CO3		L			M
	CO4	L		H		
	CO5		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CMOS SCALING CHALLENGES IN NANOSCALE REGIMES

9

Leakage current mechanisms in nanoscale CMOS, leakage control and reduction techniques, process variations in devices and interconnects. Device technologies for sub 100nm CMOS: Silicidation and Cu-low k interconnects, strain silicon – biaxial stain and process induced strain; Metal-high k gate; Emerging CMOS technologies at 32nm scale and beyond – FINFETs, surround gate nanowire MOSFETs, heterostructure (III-V) and Si-Ge MOSFETs.

UNIT II DEVICE SCALING AND BALLISTIC MOSFET

9

Two dimensional scaling theory of single and multigate MOSFETs, generalized scale length, quantum confinement and tunneling in MOSFETs, velocity saturation, carrier back scattering and injection velocity effects, scattering theory of MOSFETs.

UNIT III EMERGING NANOSCALE DEVICES

9

Si and hetero-structure nanowire MOSFETs, carbon nanotube MOSFETs, quantum wells, quantum wires and quantum dots; Single electron transistors, resonant tunneling devices.

UNIT IV NANOSCALE CMOS DESIGN

9

CMOS logic power and performance, voltage scaling issues; Introduction to low power design; Performance optimization for data paths.

UNIT V NANOSCALE CIRCUITS

9

Statistical circuit design, variability reduction, design for manufacturing and design optimization; Sequential logic circuits, registers, timing and clock distribution, IO circuits and memory design and trends. Non-classical CMOS: CMOS circuit design using non-classical devices – FINFETs, nanowire, carbon nanotubes and tunnel devices.

TEXT BOOK:

1. Lundstrom, M., “Nanoscale Transport: Device Physics, Modeling, and Simulation”, Springer. 2000
2. Maiti, C.K., Chattopadhyay, S. and Bera, L.K., “Strained-Si and Heterostructure Field Effect Devices”, Taylor and Francis, 2007
3. Hanson, G.W., “Fundamentals of Nanoelectronics”, Pearson, India., 2008.

REFERENCES BOOK:

1. Wong, B.P., Mittal, A., Cao Y. and Starr, G., “Nano-CMOS Circuit and Physical Design”, Wiley, 2004
2. Lavagno, L., Scheffer, L. and Martin, G., “EDA for IC Implementation Circuit Design and Process Technology”, Taylor and Francis, 2005

Course Code MAE101	Course Name: ADVANCED DIGITAL 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					
To introduce the Concepts of silicon realization of ASIC and Cmos devices at deep Level					
To study and apply the deep Submicron concepts to Cmos low power devices					
COURSE OUTCOMES (COs)					
CO1	To learn about random signal processing				
CO2	To know about spectrum and linear estimation.				
CO3	To know about adaptive filters				
CO4	To understand the concepts related to Adaptive Filters				

CO5	To understand the concepts related to multirate digital signal processing					
Mapping of Course Outcomes with 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			
	CO2	M				
	CO3		H			
	CO4			M		
	CO5					H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 DISCRETE RANDOM SIGNAL PROCESSING

9

Discrete Random Processes, Expectations, Variance, Co-variance, Scalar product, Energy of Discrete Signals- Parseval's Theorem, Wiener Khintchine Relation- Power Spectral Density- Periodogram- Sample Autocorrelation- Sum Decomposition Theorem, Spectral Factorization Theorem- Discrete Random Signal Processing by Linear Systems- Simulation of White Noise- Low Pass filtering of white noise.

UNIT-II SPECTRUM ESTIMATION

9

Non-Parametric Methods- Correlation Method- Co-Variance Estimator- Performance Analysis of Estimator- Barlett Spectrum Estimation - Welch Estimation- Model Based Approach- AR, MA, ARMA Signal Modeling - Parameter Estimation using Yule-Walker Method.

UNIT-III LINEAR ESTIMATION AND PREDICTION

9

Maximum likelihood criterion- efficiency of estimator- least mean squared error criterion- Wiener filter - Discrete Wiener Hoff Equation- Recursive estimators- Kalman filter- linear prediction, prediction error whitening filter, inverse filter- Levinson recursion, Lattice realization and Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT-IV ADAPTIVE FILTERS

9

FIR adaptive filters- Newton's steepest descent method- adaptive filter based on steepest descent method- Widrow Hoff LMS adaptive algorithm- Adaptive channel equalization-

Adaptive echocancellation-Adaptive noise cancellation –RLS adaptive filter-Exponentially weighted RLS –Sliding window RLS –Simplified IIRLMS adaptive filter.

UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING

9

Mathematical description of sample rate-interpolation and Decimation-continuous time model direct digital approach-Decimation by an integer factor–interpolation by an integer factor-Single and multistage realization-poly phase realization-Application to Sub band coding-Wavelet transform and filter bank implementation of wavelet expansion of signals.

TEXTBOOKS:

1. Monson.H.Hayes, Statistical Digital Processing and Modelling, John Wiley and Sons.INC, New York.1996.

REFERENCES BOOK:

1. Sophocles J.Orfanidis, Optimum Signal Processing, McGraw Hill.1990.
2. John.G.Proakis, Dimitris G.Manofakis.Digital Signal Processing Prentice Hall of India, 1995.

Course Code MAE004	Course Name: ELECTROMATIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Testing of VLSI Circuits					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES EMI Environment and EMI Coupling Principles and EMI Specification, Standards and Limits and EMI Measurements and Control Techniques and EMC Design of PCBs.						
COURSE OUTCOMES (COs)						
CO1	Ability to analyze Electromagnetic interference effects in PCBs					
CO2	Ability to propose solutions for minimizing EMI in PCBs					
CO3	To understand UMI Test instruments/systems,EMI Test					
CO4	To understand the EMI Control Techniques					
CO5	To understand the EMC Design of PCBs					
Mapping of Course Outcomes with 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			M		
	CO2				L	
	CO3		H			
	CO4		M			M
	CO5	L				

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

UNIT-I EMI ENVIRONMENT/SPECIFICATIONS /STANDARDS

10

Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters, unit of specifications, Civilian standards, and Military standards.

UNIT-II EMI COUPLING PRINCIPLES

10

Conducted, Radiated and Transient Coupling, common impedance ground coupling, radiated common mode and ground loop coupling radiated differential mode coupling, near field, cable to cable coupling, power mains and power supply coupling.

UNIT-III MEASUREMENTS

8

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-IV EMI CONTROL TECHNIQUES

8

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, signal Control, Component Selection and mounting.

UNIT-V EMC DESIGN OF PCBS

9

PCB Traces Cross Talk, Impedance Control, Power Distribution decoupling, Zoning, Motherboard Designs and propagation Delay performance models.

TEXT BOOKS:

1. Bernhard Kerker, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed 1986.
2. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, New York, 1986.

REFERENCE BOOKS:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1986.

Course Code MVL010	Course Name: OPTIMIZATION TECHNIQUES IN VLSI DESIGN	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				
OBJECTIVES						
To Know in detail about the optimization techniques and to gain knowledge on Genetic algorithms and To learn implementation of genetic algorithms for VLSI physical design problems and To understand implementation of genetic algorithms for testing of VLSI circuits and technology mapping.						
COURSE OUTCOMES (COs)						
CO1	To Know in detail about the Statistical Modeling					
CO2	To learn implementation of genetic algorithms for VLSI physical design problems					
CO3	To Know in detail about the optimization techniques					
CO4	To understand implementation of genetic algorithms for testing of VLSI circuits					
CO5	To understand implementation of genetic algorithms for technology mapping					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	E
2	CO1		H			
	CO2	M				
	CO3		H			L
	CO4				H	
	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I STATISTICAL MODELING

9

Modeling sources of variations, Monte Carlo techniques, Process variation modeling- Pelgrom's model, Principal component based modeling, Quad tree based modeling, Performance modeling-Response surface methodology, delay modeling, interconnect delay models

UNIT II STATISTICAL PERFORMANCE, POWER AND YIELD ANALYSIS

9

Statistical timing analysis, parameter space techniques, Bayesian networks Leakage models, High level statistical analysis, Gate level

statistical analysis, dynamic power, leakage power, temperature and power supply variations, High level yield estimation and gate level yield estimation

UNIT III CONVEX OPTIMIZATION

9

Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floor planning, wire sizing, Approximation and fitting- Monomial fitting, Maxmonomial fitting, Posynomial fitting.

UNIT IV GENETIC ALGORITHM

9

Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement,routing technology,Mapping for FPGA- Automatic test generation- Partitioning algorithm Taxonomy-Multiway Partitioning Hybrid genetic-encoding-local improvement-WDFRComparison of Cas-Standard cell placement-GASP algorithm-unified algorithm.

UNIT V GA ROUTING PROCEDURES AND POWER ESTIMATION

9

Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures.Power estimation-application of GA-Standard cell placement-GA for ATG-problem encoding- fitness function-GA vs Conventional algorithm.

TEXT BOOKS:

1. Ashish Srivastava, Dennis Sylvester, David Blaauw “Statistical Analysis and Optimization for VLSI:Timing and Power” , Springer, 2005.
2. Pinaki Mazumder, E.Mrudnick, “Genetic Algorithm for VLSI Design,Layout and test Automation”, Prentice Hall,1998

REFERENCES BOOK:

1. Stephen Boyd, Lieven Vandenberghe “Convex Optimization”, Cambridge University

Course Code MVL011	Course Name: VLSI FOR WIRELESS COMMUNICATION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Wireless communication				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES To study the design concepts of low noise amplifiers and to study the various types of mixers designed for wireless communication and to study and design PLL and VCO.					
COURSE OUTCOMES (COs)					
CO1	To know the concepts related to wireless communication in VLSI which can be efficiently implemented in real time.				
CO2	To study the design concepts of low noise amplifiers.				
CO3	To study the various types of mixers designed for wireless communication.				
CO4	To study and design PLL and VCO.				
CO5	To understand the concepts of CDMA in wireless communication.				

Mapping of Course Outcomes with 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		
	CO2	M				
	CO3		M		M	
	CO4		H			L
	CO5				H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I COMPONENTS AND DEVICES

9

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers

UNIT II MIXERS

9

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise- A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

UNIT III FREQUENCY SYNTHESIZERS

9

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).

UNIT IV

SUB SYSTEMS

9

Data converters in communications, adaptive Filters, equalizers and transceivers

UNIT V IMPLEMENTATIONS

9

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System .

Text Book:

1. B.Razavi ,”RF Microelectronics” , Prentice-Hall 1998.
2. Bosco H Leung “VLSI for Wireless Communication”, Pearson Education, 2002.
3. Thomas H.Lee, “The Design of CMOS Radio –Frequency Integrated Circuits’, Cambridge University Press ,2003.

REFERENCES :

1. Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design - Circuits and Systems”, Kluwer Academic Publishers, 2000.
2. Behzad Razavi, “Design of Analog CMOS Integrated Circuits” McGraw-Hill, 1999.
3. J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design,” Boston, Kluwer Academic Pub., 1997.

Course Code MAE202	Course Name: ARCHITECTURE AND –PARALLEL PROCESSING			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 types of architectures and the importance of scalable architectures and To study the various memories and optimization of memory.							
COURSE OUTCOMES (COs)							
CO1	At the end of the course, the student will be able to:						
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.						
Mapping of Course Outcomes with 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				
	CO2			M		M	
	CO3	M	H				
	CO4		M		M		
	CO5		H				

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

UNIT-I THEORY OF PARALLESISM –PART-I

7

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

10

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

10

Parallel models, Languages and compilers, Parallel program development and environments, UNIX, MACH and OSF/1 for parallel computers.

TEXT BOOK:

1. Kai Hawang, “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 International 1994.

Course Code MED008	Course Name: REAL TIME OPERATING SYSTEMS		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: Operating Systems					
	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.						
COURSE OUTCOMES (COs)						
CO1	To understand about Operating system concepts					
CO2	To know about various application domains in RTOS.					
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		M			L
	CO2	H			H	
	CO3			M		
	CO4		H			M
	CO5			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 SYSTEMS

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 KERNEL

9

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 DOMAINS

9

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 Book:

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.A Bhur, 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 Code MED102	Course Name: EMBEDDED SYSTEMS	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite: Microprocessor and its Application					
	Course Designed by : Dept. of Electronics And Communication Engineering					
OBJECTIVES To know about the concepts of embedded hardware and to know in detail about PIC microcontroller.						
COURSE OUTCOMES (COs)						
CO1	To understand about the basics of embedded system and its software environment					
CO2	To design embedded system for real time applications.					
CO3	To know in detail about embedded microcontroller.					
CO4	To discuss about the software environment in embedded systems.					
CO5	To learn about real time operating 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		
	CO2				H	
	CO3		L			
	CO4			M		

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

UNIT – I INTRODUCTION REVIEW OF EMBEDDED HARDWARE

9

Terminology Gates – Timing Diagram – Memory – Microprocessors Busses – Direct Memory Access – Interrupts – Built – Ins on the Microprocessor – Conventions used on Schematic – Interrupt Microprocessor Architecture – Shared Data Problem – Interrupt Latency.

UNIT – II PIC MICROCONTROLLER AND INTERFACING

9

Introduction – CPU Architecture – Registers – Instruction Sets Addressing Modes – Loop Timers - Interrupts – Interrupt Timing I/O Expansion – 12C Bus Operation Serial EEPROM – Analog to Digital Converter – UART Baud Rate – Data Handling – Initialization – Special Features – Serial Programming – Parallel Slave Port.

UNIT – III EMBEDDED MICROCONTROLLER SYSTEMS

9

Motorola MC68H11 Family Architecture Registers - Addressing Modes – Programs – Interfacing Methods – Parallel I/O Interface – Parallel Port Interface – Memory Interfacing – High Speed I/O Interfacing - Interrupts – Interrupt SERVICE Routing – Features of Interrupts – Interrupt Vector and Priority – Timing Generation and Measurement – Input Capture – Output Compare – Frequency Measurement – Serial I/O Devices RS232, RS485 – Analog Interfacing – Applications.

UNIT – IV SOFTWARE DEVELOPMENT AND TOOLS

9

Embedded System Evolution Trends – Round – Robin with Interrupts – Function –One – Scheduling Architecture – Algorithms – Introduction to Assembler – Compiler – Cross Compilers and Integrated Development Environment (IDE) – Object Oriented Interfacing – Recursion – Debugging Strategies – Simulators.

UNIT –V REAL TIME OPERATING SYSTEMS

9

Task and Task States – Tasks and Data – Semaphores and Shared Data Operating System Services – Message Queues – Timer Function – Events – Memory Management – Interrupt Routines in an RTOS Environment – Basic Design Using RTOS.

TEXT BOOKS:

1. David E. Simon, "An embedded Software Primer" Pearson Education Asia, 2001.
2. John B Peat man "Design with Microcontroller" Pearson Education Asia, 1998.
3. Jonathan W. Volcano Brooks/Cole "Embedded Micro Computer Systems. Real Time Interfacing". Thomson Learning 2001.

REFERENCES BOOK:

1. Burns, Alan and Welling, Andy, "Real - Time Systems and Programming Languages", Second Edition, Harlow: Addison – Wesley – Longman, 1997
2. Raymond J. A. Blur and Donald L. Bailey, "Introduction to Real Time Systems: Design to Networking with C/C++" Prentice Hall Inc. New Jersey, 1999
3. Graham Moore, and Cylix, "Real – Time Programming: A Guide to 32 Bit Embedded Development. Reading" Addison - Wesley – Longman, 1998.

Course Code MED201	Course Name: ASIC DESIGN				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Basic ASIC							
	Course Designed by : Dept. of Electronics And Communication Engineering							
OBJECTIVES								
To learn the fundamentals of ASIC and its design methods								
COURSE OUTCOMES (COs)								
CO1	To gain knowledge about partitioning							
CO2	To analyses the synthesis							
CO3	To gain knowledge on programmable architectures for ASICs							
CO4	To understand the physical design of ASIC.							
CO5	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		
2	CO1			H				
	CO2			M				
	CO3	M			L			
	CO4		M			M		
	CO5			M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					

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

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

Ant 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.

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH-DIGITAL COMMUNICATION AND NETWORKING
(FULL TIME)
I – IV SEMESTERS

SEMESTER I						
S.NO	CODE	SUBJECT NAME	L	T	P	C
1	MMA101	Applied Mathematics for Electronics Engineers	3	1	0	4
2	MDC102	Modern Digital Communication System	3	0	0	3
3	MAE102	Advanced Digital System Design	3	0	0	3
4	MDC101	Optical Communication	3	0	0	3
5	MDC1E1	Elective-I	3	0	0	3
6	MDC1L1	Communication Lab	0	0	4	2
		TOTAL CONTACT HOURS - 23				

Total Credits: 18

SEMESTER II						
1	MDC201	Cellular Mobile Communication	3	0	0	3
2	MDC203	High Performance Communication Networks	3	0	0	3
3	MDC201	Satellite Communication	3	0	0	3
4	MDC2E2	Elective – II	3	0	0	3
5	MDC2E3	Elective-III	3	0	0	3
6	MDC2L2	Networking Lab	0	0	4	2
		TOTAL CONTACT HOURS - 22				

Total Credits: 17

SEMESTER III

1	MDC3E4	Elective – IV	3	0	0	3
2	MDC3E5	Elective – V	3	0	0	3
3	MDC3E6	Elective – VI	3	0	0	3
4	MDC3P1	Project Work Phase I	0	0	12	6
		TOTAL CONTACT HOURS - 21				

Total Credits: 15

SEMESTER IV

4	MDC4P2	Project Work Phase II	0	0	24	12
		TOTAL CONTACT HOURS - 24				12

Total Credits: 62

LIST OF ELECTIVES

1	MDC001	Digital Communication Receivers	3	0	0	3
2	MDC002	Blue Tooth Technology	3	0	0	3
3	MDC003	Microwave Integrated Circuits	3	0	0	3
4	MDC004	Network Management Protocols and Remote Monitoring	3	0	0	3
5	MAE202	Computer Architecture and Parallel Processing	3	0	0	3
6	MAE101	Advanced Digital Signal Processing	3	0	0	3
7	MAE004	Electromagnetic Interference and compatibility in System Design	3	0	0	3
8	MAE006	Artificial Intelligence and Expert System	3	0	0	3
9	MDC005	Global Tracking and Positioning System	3	0	0	3

10	MDC006	Network Design Security and Management	3	0	0	3
11	MDC007	RF System Design	3	0	0	3
12	MDC008	Switching System for Communication	3	0	0	3
13	MDC009	Radar Systems and Navigational Aids	3	0	0	3
14	MDC010	Internet Working Multimedia	3	0	0	3
15	MDC011	Advanced Radiation Systems	3	0	0	3
16		Research Methodology	3	0	0	3

MMA101	APPLIED MATHEMATICS FOR ELECTRONIC ENGINEERS			L	T	P	C
	Total Contact Hours:60			3	1	0	4
	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.							
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.						
Mapping of Course Outcomes with 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					
	CO2		M				
	CO3	H					
	CO4			M			
	CO5				L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

12

UNIT II MATRIX THEORY

12

UNIT III SPECIAL FUNCTIONS

12

UNIT IV OPERATIONS RESEARCH

12

UNIT V QUEUING THEORY

12

TEXT BOOKS:

- ### REFERENCE BOOKS:

- MDC102 MODERN DIGITAL COMMUNICATION SYSTEMS

3 0 0 3

- ☐ 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.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Recall the different number systems.

CO2: Demonstrate the simplification of Boolean expressions using Boolean algebra & K-Map method.

□

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.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S	S										
CO3	M	M	W									
CO4	M		M		S							
CO5	S	M	M									

UNIT I INTRODUCTION

8

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

10

The generator matrix & the parity check matrix. Example of linear block codes Cyclic codes. Hard decision and soft decision decoding of block codes. Performance Comparison of the above two schemes. Convolutional Codes: Transfer function of a conventional code. Optimum decoding of convolutional codes the viterbi Algorithm , 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

10

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**10**

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**7**

Model of spread spectrum digital communication system. Direct sequence spread 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.

MAE102**ADVANCED DIGITAL SYSTEM DESIGN****3 0 0 3****Course Objectives**

The students will be able to design, simulate, built and debug complex combinational and sequential circuits based on an abstract functional specification.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: This subject covers the basics of digital logic circuits and design.

CO2: Through the basic understanding of Boolean Algebra and Number systems, it introduces the student to the fundamentals of combination logic design and then to sequential circuits (both synchronous and asynchronous).

CO3: Memory systems are also covered.

CO3: There is an introduction to VHDL.

CO4: Students will be provided with an opportunity to implement the PLD based designs (using both schematic capture and VHDL) in actual chips.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	M	W	W								
CO3	S	S										
CO4	S	M	M									
CO5	M	W										

UNIT-1 ADVANCED TOPICS IN BOOLEAN ALGEBRA**9**

Shannon's expansion theorem, Consensus theorem, Octal designation, Run measure, INHIBIT/INCLUSION/AOI/Driver /Buffer gates, Gate expander, Reed Muller expansion,

Synthesis of multiple output combinational logic circuits by product map method ,Design of static hazard free and dynamic hazard free logic circuits.

UNIT-II THRESHOLD LOGIC

9

Linear separability, Unateness, Physical implementation, Dual comparability, reduced function, various theorems in threshold logic, Synthesis of single gate and multigate threshold Network

UNIT-III SYMMETRIC FUNCTIONS

9

Elementary symmetric functions, partially symmetric and totally symmetric functions, Mc Cluskey decomposition method, Unity ratio symmetric ratio functions, Symmetric ratio functions, Synthesis function by contact networks

UNIT-IV SEQUENTIAL LOGIC CIRCUITS

9

Mealy machine, Moore Machine, Trivial/ Reversible /Isomorphic sequential machines, state diagrams, State table minimization incompletely specified sequential machines ,State assignments ,Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode, Essential Hazards.

UNIT-V PROGRAMMABLE LOGIC DEVICES

9

Basic concepts, Programming technologies, Programmable Logic Element (PLE),Programmable Logic Array(PLA),System Design using PLD's-Design of combinational and sequential circuits using PLD's(CPLD).Programming PAL device using PALSAM ,Design of state machine using Algorithmic State Machines (ASM) chart as a design tool, Introduction to Field Programmable Gate Arrays –Types of FPGA, Xilinx XC 3000 series, Logic Cell Array (LCA),Configurable Logic Blocks(CLB) INPUT/OUTPUT Block(IOB)-Programmable Interconnect Point (PIP),Introduction to Actel AACT2 FAMILY AND XILINX XC 4000 families ,Design examples.

Total Periods:45

References:

1. William I.Fletcher, “An Engineering Approach to Digital Design”, PrenticeHall of India.
2. James E.Palmer, David E.Perlman, “Introduction to Digital Systems”, Tata Mc Graw Hill, 1996.
3. N.N.Biswas, “Logic Design Theory “, Prentice Hall of India, 1993
S.Devadas, A.Ghosh and K.Keutzer, “Logic Synthesis”, McGraw Hill, 1994.

MDC101 OPTICAL COMMUNICATION

3 0 0 3

Course Objective:

- ☐ Develop the fundamental knowledge about the need for biasing and its various methods.
- ☐ Analyze the small signal equivalents circuits and high frequency analysis of BJT and FET.
- ☐ Examine the characteristics of multistage amplifiers.
- ☐ Classify and compare the types of large signal amplifier.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Discuss the concepts of various biasing methods for BJT.

CO2: Analyze the BJT configurations and BJT amplifiers using small signal model.

CO3: Analyze the FET Biasing concepts, FET and MOSFET amplifier small signal analysis.

CO4: Analyze the frequency response of BJT, FET and multistage amplifiers

CO5: Explain the classification and performance of large signal amplifiers.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	W											
CO3	S	M	M									
CO4	M	W										
CO5	M	W	W									

UNIT I INTRODUCTION TO OPTICAL FIBRES

9

Evolution of Fiber Optics System – Element of an Optical Fiber Transmission Links – Ray Optics – Optical Fiber modes and configuration – mode theory of circular wave Guides – Overview of model Concept – Linearly Polarized modes – single Mode Fiber – Graded Index Fiber structure.

UNIT II SIGNAL DEGRADATION IN OPTICAL FIBERS

9

Attenuation – Absorption losses Scattering losses, trending Losses, Core Cladding losses. Signal distortion in Optical Fibers, information capacity determination – group delay – material dispersion, wave guide dispersion, signal distortion in SM Fibers – polarization mode dispersion intermodal dispersion – pulse broadening in G1 Fibers – mode coupling – design optimization of SM Fibers RI profiles and cut off wavelength.

UNIT III FIBER OPTICAL SOURCE

9

Direct and indirect bandgap materials – LED structures – Light source materials – quantum efficiency and LED power. Modulation of an LED, Laser diodes – Modes and Threshold condition – rate equations – external quantum efficiency – Resonant frequencies – Laser diode structures and radiation patterns – single mode lasers – modulation of Laser diodes, Temperature effects, introduction to quantum laser, fiber amplifiers.

UNIT IV FIBER OPTICAL RECEIVERS

9

PIN AND APD Diodes – Photo detector noise, SNR, detector response time, Avalanche Multiplication noise – Comparison of Photo detectors – Fundamental Receiver Operation – Pre-Amplifier – Error sources – Receiver configuration – Probability of error quantum limit.

UNIT V DIGITAL TRANSMISSION SYSTEM

9

Point to Point links – System Consideration – Fiber Splicing and Connectors – link power budget – risetime budget – noise effect on system performance – operation principles of WDM, solutions.

Total Period : 45

Text Book:

1.Gerd Keiser, “Optical Fiber Communication” McGraw Hill International, Singapore, 3rd edition. 2000.

References:

- 1.J.Senior, "Optical communication, Principles and Practice" , Prentice Hall of India. 1994.
- 2.J Gower, "Optical Communication System" Prentice Hall of India. 2001

MDC1LI**COMMUNICATION LAB****0 0 4 2****Course Objectives:**

- Analyze the operation of LEDs, laser diodes, and PIN photodetectors (spectral properties, bandwidth, and circuits) and apply in optical systems.
- Explain the principles of, compare and contrast single- and multi-mode optical fiber characteristics. 3. Analyze and design optical communication and fiber optic sensor systems.
- Design, build, and demonstrate optical fiber experiments in the laboratory.
- Locate, read, and discuss current technical literature dealing with optical fiber systems.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Understand the basic principles of fiber amplifiers

CO2: Be able to perform bit error rate testing and to understand how it is limited by system impairments and how to optimize system performance.

CO3: Be able to quickly assemble a fiber optic link, including source, receiver, and Propagation medium and understand its main performance limitations.

CO4: Determine the appropriateness of the choice of the ICs used in a given digital circuit.

CO5: Understand how to perform eye-diagram measurements and how to utilize this to understand system jitter, intersymbol interference, and signal-to-noise ratio.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S								M	M		
CO2	M		M						M	M		
CO3	M		S						M	M		
CO4			M	W					M	M		
CO5				M					M	M		

MDC1L1**LIST OF EXPERIMENTS**

- 1.Bpsk Generation And Detection
- 2.Bfsk Generation And Detection
- 3.Study Of Pll Using Ne565.
- 4.Fm Detection Using Pll

- 5.Two Channel Analog Tdm
- 6.Pcm Generation
- 7.Flat Top Sampling.
- 8.Pwm & Ppm Generation.

MDC201 CELLULAR MOBILE COMMUNICATION

3 0 0 3

Course objectives:

- Be acquainted with the role of cellular and mobile communications in frequency management issues.
- Be acquainted with different interference factors influencing cellular and mobile communications.
- Be able to efficiently use the background behind developing different path loss and/or radio coverage in cellular environment.

Course Outcomes:

After successful completion of this course, the students should be able to

- CO1:** Apply the cellular concepts to evaluate the signal reception performance in a cellular network.
- CO2:** Apply the traffic analysis to design cellular network with given quality of service constraints.
- CO3:** Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
- CO4:** Analyse and design receiver and transmitter diversity techniques.
- CO5:** Determine the appropriate transceiver design of multi-antenna systems and evaluate the data rate performance.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M		M							
CO2	M	M		M	M							
CO3	S		M	M	S							
CO4	S	M	M	M	S							
CO5	M	M		M	M							

UNIT I INTRODUCTION TO WIRELESS MOBILE COMMUNICATIONS 9

Histroy and evolution of mobile radio systems. Types of mobile wireless services / system – cellular , WLL , paging , Satellite systems , Standards , Future trends in personal wireless systems.

UNIT II CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS 9

Cellular concept and frequency reuse , Multiple Access schemes, channel assignment and handoff, interference and system capacity, Trunking and Erlang capacity calculations.

9

UNIT IV MODULATION AND SIGNAL PROCESSING

9

UNIT V SYSTEM EXAMPLES AND DESIGN ISSUES

9

Total Period : 45

1. Feher K, “Wireless Digital Communications”, PHI, New Delhi, 1995.
2. Rappaport T.S, “Wireless Communication”, Principles and Practice, Prentice Hall, NJ, 1996
3. Lee W.C.Y., “Mobile Communication Engineering” , Theory and Applications, Second Edition, McGraw-Hill, New York, 1998.
4. Schillewr, “Mobile Communication”, Pearson Education Asia Ltd., 2000.

Course Objectives:

- To ensure a comprehensive understanding of high speed computer network architectures
- To study mathematical models related to network performance analysis.
- To focus on current and emerging networking technologies.

After successful completion of this course, the students should be able to

CO2:Design and implement network protocols in HPCN.

C03:Analyse performance of network related issues using mathematical models.

CO4: Compare the various methods of providing connection-oriented services over an advanced

CO5: network with reference to MPLS, VPN.

[illegible]

UNIT-I BASIC OF NETWORKS**9**

Telephone, computer, cable Television and Wireless network, Networking principles, Digitalization, service integration, network services, and layered Architecture, traffic characterization and QOS, networks services, network elements and network mechanisms

UNIT-II PACKET SWITCHED NETWORKS**9**

CSI and IP models: Ethernet (IEEE 802.3), token ring (IEEE 802.5) FDDL, DQDB, frame relay, SMDS, internet working with SMDS

UNIT-III INTERNET AND TCP/IP NETWORKS**9**

Overview, internet protocol, TCP and UDP, performance of TCP/IP networks circuit switched networks, SONET, DWDM, Fibre to home, DSL, Intelligent networks, CATV.

UNIT-IV ATM AND WIRELESS NETWORKS**9**

Main features- addressing, signaling and routing, ATM header structure- adaptation layer, management and control, BISDN, Interworking with ATM, Wireless channel, link level design, channel access, Network design and wireless networks.

UNIT-V OPTICAL NETWORKS AND SWITCHING**9**

Optical links- WDM systems, cross-connects, optical LAN'S, optical paths and networks, TDS and SDS, modular switch designs- packet switching, distributed, shared, input and output buffers

Total Periods:45**TEXT BOOKS:**

1. Jean Warland and Pravin Varaiya, High Performance Communication Networks, 2nd Edition, Harcourt and Morgan Kauffman, London, 2000
2. Leon Gracia, Widjaja, Communication networks, Tata McGraw Hill, New Delhi. 2000
3. Sumit Kaseria, Pankaj Sethi, ATM Networks, Tata McGraw Hill, New Delhi 2000.
4. Behrouz. a. Forouzan, Data communication and Networking, Tata McGraw Hill, New Delhi, 2000.

MDC201 SATELLITE COMMUNICATION**3 0 0 3****Course Objectives:**

- To provide an in-depth understanding of satellite communication technologies. To know the tools necessary for the calculation of basic parameters in a satellite communication system.
- To have an exposure to orbital mechanics, launching techniques and satellite link design.
- To analyze the different satellite access system.
- To understand GPS technology.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To be able to design satellite links- transmitter and receiver design.

CO2: To be able to design various satellite access techniques.

CO3: To be able to design and implement GPS systems applications

CO4: Specify systems design for satellite communications

CO5: Analyse the performance of satellite communications systems

CO/PO Mapping				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs				Programme Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W			M							
CO2	M			M								
CO3	S	M	M									
CO4	M				S							
CO5	M											

UNIT I

ORBITAL PARAMETERS

9

Orbital parameters, Orbital – Perturbations, Geo Stationary Orbits. Low Earth and medium Earth Orbits. Frequency Selection, Frequency Co-ordination and regulatory services. Sun transit outages, Limits of Visibility, Attitude and Orientation control. Spin Stabilization Techniques, Gimbal Platform.

UNIT II LINK CALCULATIONS

9

Space Craft Configuration, Payload and Supporting Subsystems. Satellite up link – down link, Link power Budget, C / NO , G / T , Noise Temperature. System Noise, Propagation factors, Rain and Ice Effects, Polarization Calculations.

UNIT III ACCESS TECHNIQUES

9

Modulation and Multiplexing : Voice, Data, Video, Analog and Digital Transmission Systems, Multiple Access Techniques : FDMA, TDMA, T1-T2 Carrier systems, SPADE, SS-TDMA, CDMA, Assignment Methods. Spread Spectrum Communication, Compression – Encryption and Decryption techniques.

UNIT IV EARTH STATION PARAMETERS

9

Earth station location, Propagation effect of ground, High Power Transmitter – Klystron, Crossed Field devices, Receivers: Low Noise front end amplifiers, MIC Devices, Antenna: Reflector Antennas, Cassergranian feeds. Measurements on G/T and Eb/No.

UNIT V SATELLITE APPLICATION

9

INTELSAT Series, INSAT, VSAT, Remote Sensing, Service: GSM, GPS, INMARSAT, Satellite Navigation system, Direct to homes Service (DTH), Special Service : E-Mail, Video Conferencing and internet Connectivity.

Total Periods:45

Text Books:

1. Bruce R. Elberi, “The Satellite Communication Application Hand Book” , Artech House, Boston, 1997.
 2. Wilbur L. Pritchard, Hendri Snyderwood G. Robert A. Nelson, “Satellite Communication System Engineering” , II Edition, Prentice Hall , New Jersey, 1993.
 3. Dennis Rody, “Satellite Communication” , Regents / Prentice Hall, Englewood cliffs, New Jersey, 1989.
 4. Tri T. Ha, “Digital Satellite Communication”, 2nd Edition McGraw Hill, New York, 1990.
- Feher K. “Digital Communication Satellite Earth Station Engineering” , Prentice Hall, Inc New Jersey, 1983.

MDC2L2

NETWORKING LAB

0 0 4 2

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.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Ability to design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.

CO 2: 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.

CO 4: 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.

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W			S							
CO2	S			W								
CO3	S			M		M						
CO4	S	M										
CO5	M		M									

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 posix signals.
4. Program an 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.

MDC3P1 PROJCTWORK PHASE-I

0 0 12 6

Course Objectives:

- Develop hardware solutions for simple applications.
- Learn to work in a team.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Apply knowledge of basic science and engineering to electronics and communication

engineering problems.

CO2: Identify, formulate simple problem statements and find solutions.

CO3: Implement the hardware and test.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									
CO2		S	M	M								
CO3			S	M								

Every student will be required to undertake a suitable project work in the Department during VI semester in consultation with the Head of the Department and the faculty guide and submit the project at the end of the Semester on dates announced by the Institute/Department.

MDC3P1 PROJECTWORK PHASE-II

0 0 24 12

Course 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:

After successful completion of this course, the students should be able to

CO1: Apply knowledge of basic science and engineering to electronics and communication engineering problems

CO2: Recognize the real world applications and to solve with core engineering knowledge.

CO3: Analyze and work on multidisciplinary tasks

CO4: Choose latest tools, software and equipment to solve real world problems

CO5: Identify, formulate, and model engineering equipment

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									
CO2		S	M	M								
CO3		M	M	S	S							
CO4			S	S	M							
CO5				S	S					M	M	

9

Carrier and signal synchronization, carrier phase estimation – PLL, decision director loops symbol timing estimation, maximum likelihood and non decision director timing estimation, joint estimation.

UNIT V ADAPTIVE EQUALIZATION

9

Zero facing Algorithm, LMS Algorithm, Adaptive decision – feedback equalizer and equalization of Trellis – coded signals. Kaiman Algorithm, Blind equalizers and Stochastics gradient algorithm, echo cancellation.

Total Periods : 45

Reference:

1. Heinrich Meyer, Mare Moeneclacy, Stefan A. Fechtel, “Digital Communication Receivers” Vol I and Vol II, John wiley, New York, 1997
2. John. G. Proakis, “Digital Communication” 4th Edition, McGraw-Hill, New York, 2001
3. E. A. Lee and D. G. Messerschmitt, “Digital Communication” , 2nd Edition, Allied Publishers, New Delhi, 1994
4. Simon Marvin, “Digital Communication over Fading Channel : An Unified approach to performance analysis” , John wiley, New York, 2000

MDC002

BLUETOOTH TECHNOLOGY

3 0 0 3

Course Objectives:

- The students will learn how Bluetooth devices operate in the frequency band where other devices operate including wireless LAN, microwave ovens, Cordless telephones, Wireless video cameras and others.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Graduates will demonstrate the ability to identify, formulate and solve engineering problems

CO2: Graduates will demonstrate the ability to design a system, component or process as per needs and specifications.

CO3 Graduates will demonstrate the ability to visualize and work on laboratory and multidisciplinary tasks.

CO 4 Graduate will demonstrate the skills to use modern engineering tools, software’s and equipment to analyze problems. j) Graduate will develop confidence for self education and ability for life-long learning.

CO5 Graduates will show the ability to participate and try to succeed in competitive examinations

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

Origin, blue tooth sig, protocol stack, security, applications and profiles, management, test and qualification and technology basics, RF and IR wireless communication

UNIT-II BLUETOOTHMODULE

9

Antennas patterns, gain and losses : types of antennas: on chip antennas radio interface: Fh modulation symbol timing, power emission and control , performance parameters, Rf Architecture, Bluetooth, based band: blue tooth device address system timing, physical links, packet, structuring types and construction ,channel coding and time base synchronisation

UNIT-III LINK CONTROLLER AND MANAGEMENT

9

Link, controller states, pico net and scattered operations, master/slave role switching Link Architectural overview, Link set up , quality of service, Link version, name represent, test mode

UNIT-IV BLUETOOTH HOST

9

Link and adaptation protocol L2cap signaling : connection; Bluetooth profiles, version 1.0 , generic profiles, serial and object exchange

UNIT-V SECURITY

9

Encryption and security key generation, security mode and architecture, low power operation and Qos management

Total Periods:45

References:

1. Bluetooth connect without cables Jennifer Bray and C. F. Stuntman pearson education 2001
2. Bluetooth revealed: Brent A. Miller and C. Bisdikian, pearson education 2001
3. Bluetooth Demystified Nathan J. Miller Tata Mc graw Hill 2001

MDC003 MICROWAVE INTEGRATED CIRCUITS

3 0 0 3

Course Objectives:

- Understand microwave distributed circuit elements.
- Understand RF and Microwave circuit elements.
- Understand microwave circuit analysis techniques.
- Understand transmission line circuits and Microstrip lines.
- Understand S-parameters and network characterization techniques.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Ability to apply knowledge of advanced principles to the analysis of electrical engineering problems.

CO2:Ability to apply knowledge of advanced techniques to the design of electrical engineering systems.

CO3:Ability to apply the appropriate industry practices, emerging technologies, state-of-the-art design techniques, software tools, and research methods of solving electrical engineering problems.

CO4:Ability to learn new subjects that are required to solve problems in industry without Being dependent on a classroom environment.

CO5:Ability to be competitive in the engineering job market or be admitted to an excellent Ph. D. program.

CO/PO Mapping				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs				Programme Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I MICROSTRIPS LINES, DESIGN, ANALYSIS

9

Introduction, types of MICs and their technology, Propagating modes, Analysis of MIC by conformal transformation, Numerical analysis, Hybrid mode analysis losses in Microstrip. Introduction to slot line and coplanar wave guide.

UNIT II COUPLED MICROSTRIP, DIRECTIONAL COUPLERS AND LUMPED ELEMENTS FOR MICs

9

Introduction to coupled Microstrip, Even and odd mode analysis, Directional couplers, branch line couplers, Design and Fabrication of Lumped elements for MICs, Comparison with distributed circuits.

UNIT III NON-RECIPROCAL COMPONENTS AND ACTIVE DEVICES FOR MICs

9

Ferromagnetic substrates and insert, Microstrip circulation, Phase shifter, Microwave transistor, Parameter diodes and Amplifiers, PIN Diodes. Transferred electron devices. IMPATT, BARITT, Avalanche diodes, Microwave transistor circuits.

UNIT IV MICROSTRIP CIRCUIT DESIGN AND APPLICATION

9

Introduction, Impedance transformers, Filters, High Power Circuits, Low Power Circuits, MICs in satellite and Radar.

UNIT V MMIC TECHNOLOGY

9

Fabrication process of MMIC, Hybrid MICs, Configuration Dielectric substances, thick and thin film technology, testing methods, Encapsulation and mounting of devices.

Total Period : 45

REFERENCE:

1. Huffman R. K "Hand book of Microwave Integrated Circuits" , Artech House Boston 1989
2. Guta K. C. S Amarjit singh "MIC" John Willey , New York, 1975

MDC004 NETWORK MANAGENENT PROTOCOLS AND REMOTE MONITORING

3 0 0 3

Course Objectives:

- The objective of the course is to provide basics of network management.
- Appreciate the need for interoperable network management
- Understand general concepts and architecture behind standards based network management Understand concepts and terminology associated with SNMP and TMN
- Appreciate network management as a typical distributed application Get a feeling of current trends in network management technologies
- Understand Advanced Information Processing Techniques such as Distributed Object Technologies, Software Agen

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Simple Network Management

CO2: Remote Network Monitoring in TCP/IP Networks

CO3: Advanced Management of TCP/IP Networks

CO4: Management of Telecommunication Networks

CO5: Internet Technologies for Converged Networks Management

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I NETWORK MANAGEMENT FUNDAMENTALS

9

Network monitoring-Network control

UNIT II SNMP I

9

SNMP network management concepts SNMP management information standard MIBBS-Simple network managements protocol

UNIT III RMON

9

Remote network monitoring, Statistics collection – remote network monitoring – Alarms and filters – RMONS2

UNIT IV SNMP-3

9

Management information protocol MIBs and conformance

UNIT V SNMP-3

9

Cryptographic Algorithms Architecture and Application – Manage Processing and user based security models – View based access control model – TCP/IP protocol suite – TCP/IP standards

Total Periods : 45

References:

1. “Network Management protocols and Remote Monitoring”, William Stalling, 3rd Edition, Pearson Education

MAE202 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING 3 0 0 3

Course Objectives:

- To learn the parallel models and processors
- Pipelining and scalable architectures
- To learn the multithread and data flow architecture

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: An ability to understand the operations of multiprocessor and multicomputer systems.

CO 2:To understand the various advanced processor technology, pipelining and scalable architectures.

CO 3:To know the working of superscalar pipeline, cache memory organization.

CO 4:To understand the principles of multithreading, multithread architecture.

CO5: Static and dynamic data flow.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I THEORY OF PARALLELISM – PART I

8

Parallel computer models – the state of computing. Multiprocessors and multicomputer and Multivectors and SIMD computers, PRAM and VLSI mode Architectural development tracks. Program and network properties conditions of parallelism.

UNIT II THEORY OF PARALLELISM – PART – II

7

Program portioning and scheduling, Program flow mechanism, System interconnect Architectures, 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 organization, shared memory organization, sequential and weak consistency model.

UNIT IV PIPELINING AND SUPERSCALAR TECHNOLOGIES

10

Parallel and scalable architectures, Multiprocessor and Multicomputers, Multivector and SSIMD computers, Scalable, Multithreaded and data flow architectures.

UNIT V SOFTWARE AND PARALLEL PROGRAMMING

10

Parallel Models, Languages and compilers, Parallel program development and environments, UNIX, MACH and OSF / 1 for parallel computers.

Total Periods: 45

Reference:

1. Kai Hwang, “Advanced Computer Architecture” , McGraw Hill International, 1993.
2. William Stallings, “Computer Organization and Architecture” , Macmillan Publishing Company, 1990.
3. M. J. Quinn, “Designing Efficient Algorithms for Parallel Computer,” McGraw Hill International 1994.

MAE101

ADVANCED DIGITAL SIGNAL PROCESSING

3 0 0 3

Course Objectives:

- Sampling, aliasing and the relationship between discrete and continuous signals

- Review of Fourier transforms, the Z-transform, FIR and IIR filters, and oscillators
- Filter implementation techniques, structures and numerical round-off effects
- Filter design techniques

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Auto-correlation, cross-correlation, and power spectrum estimation techniques

CO2: Linear prediction Wiener filters .

CO3: Multi-rate signal processing and subband transforms.

CO4: Time-frequency analysis, the short time Fourier transform, and wavelet- transforms

CO5: LMS adaptive filters, and applications

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I DISCRETE RANDOM SIGNAL PROCESSING

9

Discrete Random Processing – Expectations – Variance – Co-Variance – Scalar Product – Energy of Discrete Signals – Parseval’s Theorem – Wiener Khintchine Relation – Power Spectral Density – Periodogram – Sample Autocorrelation – Swum Decomposition Theorem – Spectral Factorization Theorem – Discrete Random Signal Processing by Linear Systems – Simulation of White noise – Low Pass Filtering of White Noise.

UNIT II SPECTRUM ESTIMATION

9

Non – Parametric Methods – Correlation Method – Co-Variance Estimator – Performance Analysis of estimation Unbiased – Consistent Estimators – Periodogram Estimator – Barlett Spectrum Estimation – Welch Estimation – model Based Approach – AR, MR, ARMA Signal Modelling – Parameter Estimation Using Yule – Walker Method

UNIT III LINEAR ESTIMATION AND PREDICTION

9

Maximum likelihood criterion – Efficiency of Estimator – Least Mean Square error criterion – Wiener Filter – Discrete Wiener Hoff equation – Recursive estimators – Kalman filter – Linear prediction, Prediction error whitening filter, inverse filter – Levinson recursion, Lattice Realization and Levinson Recursion Algorithm for Solving Toeplitz System of Equations.

UNIT IV ADAPATIVE FILTERS

9

FIR adaptive Filters – Network’s steepest descent method – Adaptive Filter based on Steepest descent method – Widrow Hoff LMS adaptive algorithm – Adaptive Channel Equalization – Adaptive echo canceller – Adaptive Noise cancellation – RLS adaptive filter – Exponential Weighted RLS – Sliding Window RLS – Simplified IIR LMS adaptive filter.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING

9

Mathematical description of change of sampling rate – Interpolation and Decimation – Continuous line model direct digital domain approach – Decimation by an integer factor – interpolation by an integer factor – Single and Multistage Realization – Poly phase realization –

Application to sub band coding – Wavelet Transform and Filter bank implementation of wavelet expansion of signals.

Total Periods: 45 Hrs

Text Books:

1. Monson H. hayes, Stastical Digital Signal Processing and Modeling, John Wiley and Sons, Inc., New York, 1996.

References:

1. Sopocles, J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1910.
2. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing” Prenctice Hall of India, 1995.

MAE004 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

3 0 0 3

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

Course Outcomes:

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.

CO 2:Designing electronic systems that function without errors or problems related to electromagnetic compatibility

CO 3:Diagnose and solve basic electromagnetic compatibility problems.

To be able to apply Maxwell’s equations for electromagnetic systems.

CO 4: To able to design systems to mitigate the effects of Electromagnetic Interference.

CO 5 To design systems with Electromagnetic compatibility

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W			M							
CO2	M			M								
CO3	S	M	M									
CO4	M				S							
CO5	M			S								

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.

MAE006 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 3 0 0 3

Course Objectives:

- AI programs that achieve expert-level competence in solving problems in task areas by bringing to bear a body of knowledge about specific tasks are called knowledge-based or expert systems.
- The term expert systems is reserved for programs whose knowledge base contains the knowledge used by human experts, in contrast to knowledge gathered from textbooks or non-experts.
- More often than not, the two terms, expert systems (ES) and knowledge-based systems (KBS), are used synonymously.
- The area of human intellectual endeavor to be captured in an expert system is called the task domain. Task refers to some goal-oriented, problem-solving activity.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Concepts of Artificial Intelligence and Expert System Concepts. Examine methods that have emerged from both fields

CO 2: 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.

CO 4: Analyze and design a neural network system using neural network toolbox.

CO 5: Analyze and design a rule-based expert system.

					CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W			S							
CO2	M											
CO3	S	M	M	S								
CO4	M				M							
CO5	M			M								

UNIT-I-INTRODUCTION TO ARTIFICIAL INTELLIGENCE

9

Overview of AI-general concepts- problem spaces and search- Search techniques –BFS, DFS- Heuristic search techniques

UNIT-II KNOWLEDGE REPRESENTATION

9

Knowledge- general concepts – predicate logic – representing simple fact- instance and ISA relationships- Resolution – Natural deduction

UNIT-III KNOWLEDGE ORGANISATION AND MANIPULATION

9

Procedural versus Declaration knowledge – forward vs Backward reasoning- matching techniques- control knowledge/strategies – symbol reasoning under uncertainty- introduction to non –monotonic- reasoning- logic for monotonic reasoning

UNIT-IV PERCEPTION-COMMUNICATION AND EXPERT SYSTEMS

9

Natural language processing – pattern recognition- visual image understanding – Expert system architecture

UNIT-V KNOWLEDGE ACQUISITION

9

Knowledge acquisition- general concepts – learning – learning by introduction- Explanation based learning

Total periods: 45

Text books:

1. Elaine Rich and kelvin Knight, Artificial Intelligence, Tata mcgraw Hill, New Delhi
2. Stuart Russell and peter Norvig , Artificial Intelligence : A modern approach, Prentice Hall,1995

References:

1. Nilson N. J.Principles of Artificial Intelligence ,SpringrVerlag – Bergin,1980.
2. Patrson, Introdution of Artificial intelligence and Expert systems prentice Hall of India, New Delhi,1990

MDC005 GLOBAL TRACKING AND POSITIONING SYSTEMS

3

0 0 3

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.

Course Outcomes:

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;

CO 2: produce a simple map from field data acquired using hand-held GPS.

CO 3: 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 team towards relevant research front in Global positioning and navigation systems

CO5: Ability to identify the global positioning satellite data interface and relation with other related disciplines, ability to understand the international perspective of satellite positioning

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M			S								
CO3	S	M	M									
CO4	M				M							
CO5	M											

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 acquisition 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 Wiley & Son, 2001.
2. E.D. Kaplan, “Understanding GPS Principles and applications”, Arctech house Boston 1996.

Course Objectives:

- Describe and analyze the hardware, software, components of a network and the interrelations.
- Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- Manage multiple operating systems, systems software, network services and security. Evaluate and compare systems software and emerging technologies.
- Develop solutions for networking and security problems, balancing business concerns, technical issues and security.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: The students shall have knowledge about firewall technologies to secure the network perimeter

CO2: The students shall have knowledge Intrusion Prevention, Configure IPS to mitigate attacks on the network

CO3: The students shall have knowledge secure network management and reporting

CO4: The students shall have knowledge an adaptive security appliance (ASA) firewall technologies to secure the network perimeter.

CO5: The students shall have knowledge site-to-site IP Sec VPNs

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I PRINCIPLES OF NETWORK AND DESIGN**9**

Design Objectives – Understanding Networking Environment – Achieving Design Goals – Importance of being predictable and fundamental design principles. Designing the campus LAN – Campus Network Design Goals – Understanding the Campus Network – Designing the LAN Topology – Campus Hierarchical design.

UNIT II DESIGNING THE WAN**9**

Designing the WAN topology – Flat versus Hierarchical – Flat WAN Topology – Limitation of a Flat Design – Hierarchical WAN Topology – PVC and Leased Line Aggregation – Issues with Hierarchical design – Hierarchical layers – WAN design Parameters – Choosing the WAN technology - Design consideration for Serial links – Designing IP Over frame relay and ISDN Design issues with IP – Fundamental IP routing design – Designing an IP addressing plan – Categorising IP routing protocol and RIP.

UNIT III SECURITY PROBLEM AND CRYPTOGRAPHY**9**

Security attacks – Services and mechanism – conventional and encryption model – Steganography – classical encryption techniques – simplified DES – Block cipher principles – DES Standards – Principles of Public Key Crypto systems –RSA Algorithm – Key management – Diffie Hellman Key Exchange – Authentication codes Hash functions – Kerberos.

UNIT IV NETWORK SECURITY

9

E-Mail Security – Pretty – Good Privacy – S / MIME – IP Security – Overview and Architecture – authentication header – encapsulating security payload – combining security associations – web security requirements SSL-TLS – Secured electronic transactions – intruders – higher wall design principles – trusted systems.

UNIT V NETWORK MANAGEMENT

9

Network management – requirements and systems – network monitoring architecture – performance monitoring – Account monitoring – configuration control – security control – SNMP background and concepts – structure of management information – SNMP protocols – basic concepts – specifications – transport level support – groups.

Total Periods: 45

TEXT BOOKS:

1. Cormac long “IP Network design” tmh 2001.
2. William stallings “cryptography and network security principles and practice” pearson education asia, prentice hall 2004
3. William Stalling SNMP, SNMP V2, SNMP V3, RMON 1 and 2 pearson education asia third edition 2001

REFERENCES:

1. Charles p. pfleeger “security in computing prentice hall, 1989
2. Bruce Schneier “applied cryptography” John Wiley & sons inc. second edition,. 2004.
3. Ed.taylor “networking handbook” tmh, 2000.
4. Mani subramaniam “network management” – principle and practice “Pearson Education Asia”.

MDC007

RF SYSTEM DESIGN

3 0 0 3

Course Objectives:

- To design and analyse basic resonators and RF Filters.
- To study the operation and device characteristics of RF Active components.
- To design and analyze RF transistor amplifier.
- To understand the operation of Oscillators and mixers used in RF design

Course Outcomes:

After successful completion of this course, the students should be able to

CO1:This course provides the foundation for designing and analysis of RF circuits. Through lecture and out-of-class assignments, students are provided learning experiences that enable them to

CO2: To discuss design and analysis of filters and amplifiers.

CO3: To understand the working concepts of RF active components.

CO4: To study the operation of mixers and oscillators.

CO5:Design active RF sub-systems for applications ranging from sensing, measurements and telecommu- nications;

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I RF FILTER DESIGN

9

Basic resonator and filter configurations – special filter realization – filter implementation – coupler filter.

UNIT II ACTIVE RF COMPONENTS

9

RF diodes – bipolar junction transistor – RF field effect transistor – high electron mobility transistors – diode models – measurement of active devices – scattering parameter device characterization.

UNIT III MATCHING AND BIASING NETWORKS

9

Impedance matching using discrete components – microstrip line matching, networks – amplifier classes of operation and biasing networks.

UNIT IV RF TRANSISTOR AMPLIFIER DESIGN

9

Characteristics of amplifier – amplifier power relations – stability consideration – constant gain – broadband, high power and multistage amplifiers.

UNIT V OSCILLATORS AND MIXERS

9

Basic oscillator model – high frequency oscillator configuration – basic characteristics of mixer.

Total Period: 45

TEXT BOOK

1. Reinhold Ludwig “RF Circuit Design, theory and application” “Pearson Asia Education”, Edition 2001.

Reference Books:

1. D. POZAR, “Microwave Engineering”, John Wiley & Sons, New York, 1998.
2. Bahil and P. Bharatia “Microwave Solid State Circuit Design, John Wiley & Sons, New York, 1998.

MDC008 SWITCHING SYSTEM FOR COMMUNICATION

3 0 0 3

Course Objectives:

- The course objectives are to provide the student with knowledge of digital network switching and transmission design. These objectives will be achieved by providing students with an understanding of various types of technologies used by telecommunication companies and service provider networks that form the basis of the backbone network.
- Students will be provide with the necessary knowledge to examine the network design principles and concepts that are used to implemented networks by taking into account commercial realities and practices.
- Student capability development includes gaining an understanding of the factors associated with the provision of network services, including an understanding of how network switching and transmission design can impact on the operation of the network.
- **Course Outcomes:**

After successful completion of this course, the students should be able to

CO1: Independently understand basic computer network technology.

CO2: Understand and explain Data Communications System and its components.

CO3: Identify the different types of network topologies and protocols.

CO4: Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer

CO5: Identify the different types of network devices and their functions within a network

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I EVOLUTION OF TELECOMMUNICATION SWITCHING AND CIRCUITS 9

Evolution of Public Switched Telecommunication Networks Stronger Exchange, Crossbar Exchange, Stored Program Exchange, Digital Exchange – Basic Telecommunication Equipments – Telephone Handset, Hybrid Circuit, Echo Suppressors and Cancellers, PCM encoders.

UNIT II ELECTRONIC SWITCHING 9

Circuit switching, Message Switching, Centralized program switching, line switching, Space switching, Combination switching – Digital switching system hardware configuration, switching system software, (organization), A Switching System call processing software. Hardware software integration.

UNIT III TELECOMMUNICATION SIGNALLING AND TRAFFIC 9

Channel associated signaling, Common channel signaling, SS7 signaling protocol, SS7 protocol architecture, Concept of Telecommunication traffic, Grade of service, Modeling switching system, Blocking models and delay systems.

UNIT IV INTEGRATED DIGITAL NETWORKS 9

Subscriber loop characteristics, Local access wire line and wireless PCM / TDM carrier standards transmission line codes, Digital multiplexing techniques, Synchronous, Asynchronous, multiplexing techniques, SONET / SDH, Integrated digital networks (IDN) environment – Principles of Integrated Services Digital Network (ISDN) – Cellular Mobile Communication Principles

UNIT V DATA NETWORKS 9

Data transmission in PSTN – Connection oriented and connection less protocols – packet switching – ISO – OSI architecture – Satellite based data networks – Multiple access techniques – LAN, WAN – Standards – TCP / IP – Internet – Principles of ATM networks

Total Periods: 45

Text Books:

1. Viswanathan T, "Telecommunication Switching System and Networks", Prentice Hall of India, Ltd., 1994

2. Behrouz Forouzan, “Introduction to Data Communication and Networking”, McGraw – Hill, 1998

References:

1. L.S. Lawton, “Integrated Digital Networks”, Galgotia Publications Pvt. Ltd., New Delhi, 1996

MDC009 RADAR SYSTEMS AND NAVIGATIONAL AIDS

3 0 0 3

Course Objectives:

- Fundamentals of Radar
- Different types of Radar and their working
- Radar signal Detection technique

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To become familiar with fundamentals of RADAR

CO2 To gain indepth knowledge about the different types of RADAR and their

operations **CO3:** Need for signal detection in RADAR and various detection techniques

CO4: To become familiar with RADAR navigation techniques

CO5: Graduates will demonstrate the ability to design a system, component or process as per needs and specifications

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT I RADAR EQUATION

9

Radar block diagram and operation: Radar Frequencies, Radar Range equation: Prediction of range performance: minimum detectable signal; Radar cross section of targets, cross section Fluctuation: transmitter power; pulse repetition frequency and range ambiguities: system loss and propagation effects.

UNIT II CW AND FMCW RADAR

9

Doppler effect CW radar – basic principles and operation of FMCW radar, MTI and pulse Doppler radar – MTI Block diagram and description: delay line cancellers: range gated Doppler fitters: non coherent MTI: Pulse Doppler radar. Tracking radars – sequential lobbing: conical scan and simultaneous lobbing mono pulse.

UNIT III SYNTHETIC APERTURE AND AIR SURVEILLANCE RADAR

9

Synthetic radar – resolution: Radar equation: SAR signal processing, inverse SAR. Air Surveillance radar – Users requirements characteristics and frequency considerations

ECCM AND BISTATIC RADAR

Electronic counter measures: bistatic radar – description bistatic radar equation – comparison of monostatic and bistatic radars.

UNIT IV RADAR SIGNAL DETECTION AND PROPAGATION ON WAVES

9

Detection criteria: automatic detection, constant false alarm rate receiver, information available from a radar, earth, refraction, anomalous propagation and diffraction. Introduction to clutter, surface clutter, radar equation.

UNIT V ELECTRONIC NAVIGATION

9

Adcock directional Finder – automatic direction finder – VHF omnidirectional range – hyperbolic system of navigation – Toran and decca navigation system – tactical air navigation. (TACAN) ILS and GCA as aids to approach and landing.

Total Periods: 45

References:

1. M. I. Skolnik, “Introduction to radar system” – McGraw Hill 2nd edition
2. N. S. Nagaraja, Elements of electronic navigation – Tata McGraw Hill, 1993.
3. NADAV Levanon, Radar Principles – John Wiley and sons 1989
4. Brookner, radar Technology – Artech Hons 1986.

MDC010 INTERNET WORKING MULTIMEDIA

3 0 0 3

Course Objectives:

Internet applications development and Internet programming. As a result of studying the discipline a student must understand and be able to explain the basic concepts and principles for the development of Internet applications and Internet programming

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Describe different realisations of multimedia tools and the way in which they are used

CO2: analyse the structure of the tools in the light of low-level constraints imposed by the adoption of various QoS schemes (ie bottom up approach)

CO3: analyse the effects of scale and use on both presentation and lowerlevel requirements (ie top down approach)

CO4: plan experiments to test user perception of multimedia tools

CO5: state the properties of different media streams; compare and contrast different multicast protocols Explain the various current mirror circuits and analyze differential amplifier with active load.

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

UNIT-I INTRODUCTION

9

Digital sound, basic multimedia networking, multimedia characteristics, evolution of internet services model, network requirements for audio/video transform, multimedia coding and compression for text, image audio and video

UNIT-II SUBNETWORK TECHNOLOGY

9

Broadband services, ATM and IP, IPV6 high speed switching, resource reservation, buffer

management, traffic shaping, caching, scheduling and policing, throughput, delay and jitter performance.

UNIT-III MULTICAST AND TRANSPORT PROTOCOL 9

Multicast over shared media network, multicast routing and addressing, scaping multicast and NBMA Networks, RTP, RTCP.

UNIT-IV MEDIA- ON – DEMAND 9

Storage and media serves, voice and video over IP, MPEG-2 over ATM/IP, Indexing synchronization of requests.

UNIT-V APPLICATIONS 9

MIME, Peer- to – peer computing, shared application , video conferencing, centralized and distributed conference control, light weight session philosophy

Total Periods: 45

Text Books:

1. Jon crow croft, Mark Handley, Ian Wakeman , Internetworking Multimedia, Harcourt Asia Pvt . Ltd. Singapore, 1998
2. B .O. Szuprowicz , Multimedia Networking, McGraw Hill, New York , 1995
3. Tay Vaughan, Multimedia making it to work, 4ed, Tata McGraw Hill, New Delhi, 2000

MDC011 ADVANCED RADIATION SYSTEM 3 0 0 3

Course Objectives:

- Introduction to Radiation Protection
- Interaction of X-Radiation with Matter
- Radiation Quantities and Units
- Radiation Monitoring
- Equipment Design for Radiation Protection

Course Outcomes:

After successful completion of this course, the students should be able to

CO1 Students demonstrate their knowledge of advanced radiation measurements techniques [

CO 2.:Students will communicate in writing their insights into radiation applications

CO3: Explain the various current mirror circuits and analyze differential amplifier with active load.

CO4: Describe the characteristics, linear and non linear application of operational amplifier

CO5:Analyze the internal modules of PLL, Analog Multiplier and review its applications

CO/PO Mapping												
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M											
CO3	S	M	M									
CO4	M											
CO5	M											

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 – Babinet's principle, Geometrical theory of diffraction, reflection antennas, design considerations, slot antennas.

UNIT III SYNTHESIS 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 spiral 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**References:**

1. Kraus. J. D "Antennas", 2nd edition John Wiley and sons, 1997
2. Balanis. A. "Antenna Theory analysis and design" John Wiley and sons. New York 1982
3. Collin. R. E and Zucker "E" Antenna theory part I McGraw Hill, New York 1969.

RESEARCH METHODOLOGY**Objectives**

- To Get adequate knowledge about research concepts
- To describe mathematical modeling and simulation
- To understand experimental modeling
- To get knowledge about the interpretation of result

Course Outcomes after successful completion of this course, the students should be able to

CO 1: To describe research concepts.

CO 2: To Get adequate knowledge about mathematical modeling

CO 3: To describe experimental modeling

CO 4: To understand analysis of results.

CO 5: To know about report writing

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak							
COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	S	M				M	M
CO 2	S	M				M	M
CO 3	S	M				M	M
CO 4	S	M				M	M
CO 5	S	M				M	M

5							

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, “Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CURRICULUM AND SYLLABUS (R2015)**CHOICE BASED CREDIT SYSTEM****M.TECH - POWER ELECTRONICS AND DRIVES****(FULL TIME)****I – IV SEMESTERS**

SEMESTER I						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MMA111	PM	Applied Mathematics	3	2	0	4
MIC105	PC	Advanced Control Theory	3	0	0	3
MPE101	PC	Analysis of Power Converter	3	0	0	3
MPE102	PC	Advanced Semiconductors Devices	3	0	0	3
MPE103	PC	Analysis of Electrical Machines	3	0	0	3
MPE104	PC	System Design Using Microcontroller	3	0	0	3
Total Number of Contact Hours = 20Total Number of Credits= 19						

SEMESTER II						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MPE201	PC	Analysis of Power Inverters	3	0	0	3
MPE202	PC	Solid State AC Drive	3	0	0	3
MPE203	PC	Solid State DC Drive	3	0	0	3
MPE204	PC	Special Electrical Machines & Controllers	3	0	0	3
MPE205	PC	Power Electronics For Renewable Energy Systems	3	0	0	3
MPE2E1	PE	Professional Elective – I	3	0	0	3

PRACTICAL						
MPE2L1	PC	Power Electronics and Drives Laboratory	0	0	4	2
Total Number of Contact Hours =22Total Number of Credits= 20						

SEMESTER – III						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MPE3E1	PE	Professional Elective – II	3	0	0	3
MPE3E2	PE	Professional Elective – III	3	0	0	3
MPE3E3	OE	Open Elective – I	3	0	0	3
PRACTICAL						
MPE3P1	PR	Project Work Phase – I	0	0	12	6
MPE3S1	PR	Seminar	0	0	2	1
MPS3V1	PR	Internship/Industrial Training(During summer vacation)	0	0	2	1
Total Number of Contact Hours = 25 Total Number of Credits= 17						

SEMESTER – IV						
Course Code	Category	Course Title	L	T	P	C
PRACTICAL						
MPS4P1	PR	Project Work Phase – I	0	0	24	12
Total Number of Contact Hours = 24Total Number of Credits=12						

Total No. Of Credits – 68

LIST OF ELECTIVES

S.No	Sub code	Subject Name	L	T	P	C
PROFESSIONAL ELECTIVE (PE) – I						
1.	MPE001	Wind Energy Conversion Systems	3	0	0	3
2.	MPE002	HVDC Transmission	3	0	0	3
3.	MPE003	Design Of Intelligent Controllers	3	0	0	3
4.	MPE004	Microprocessors& Microcontrollers Applications In Power Electronics	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – II						
1.	MPE005	Power Quality	3	0	0	3
2.	MPE006	Flexible AC Transmission Systems	3	0	0	3
3.	MPE007	MEMS Technology	3	0	0	3
4.	MPE008	Neural Network And Fuzzy Logic Control	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – III						
1.	MPE009	Industrial Applications Of Electrical Drives	3	0	0	3
2.	MPE010	SCADA System and Applications Management	3	0	0	3
3.	MPE011	Smart Grid	3	0	0	3
4.	MPE012	SMPS And UPS	3	0	0	3
OPEN ELECTIVE (OE)						
1.	MPE013	Solar And Energy Storage Systems	3	0	0	3
2.	MPE014	Computer Network Engineering	3	0	0	3
3.	MPE015	Digital Signal Processing	3	0	0	3
4.	MST070	Research Methodology	3	0	0	3

SEMESTER – I

MMA111	APPLIED MATHEMATICS			L	T	P	C
	Total Contact Hours: 60			3	1	0	4
	Prerequisite:						
	Course Designed by : Dept. of Mathematics						
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 cer function spaces.							
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 and solve the fundamental problems with prescribed or free boundary conditions in simple cases.						
CO3	Learn to understand how signals, systems, inference combine in prototypical tasks of communication, control and signal processing.						
CO4	Apply concepts of Probability to solve problems in Electronic Engineering						
CO5	Find functional relationship between random inputs and outputs with the use of Random Process Techniques. Find the linearity in Birth and Death Processes with the use of Poisson 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	
2	CO1	H	H	L	M		
	CO2		H	L			
	CO3			H		M	
	CO4	M	H			L	
	CO5		H	H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				

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

UNIT I ADVANCED MATRIX THEORY

9+3

Eigen values using QR transformations generalized eigenvectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

UNIT II CALCULUS OF VARIATIONS

9+3

Variation and its properties – Euler's Equation – Functional dependent on first and higher 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.

UNIT III SPECIAL FUNCTIONS

9+3

Series solutions – Bessel's equations – Bessel functions – Recurrence relations generating functions and orthogonal of Bessel's functions of the first kind Legendry's equations, Legendry polynomials – Rodriguez's formula applications to boundary value problems

UNIT IV PROBABILITY

9+3

Probability concepts – Random variables Discrete and continuous dissimulations – Correlations – partial, multiple, rank analysis of variance one way, two way process.

UNIT V RANDOM PROCESS

9+3

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. Andrews 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.

	ADVANCED CONTROL THEORY	L	T	P	C

MIC105	Total Contact Hours:45				3	0	0	3
	Prerequisite: Control system							
	Course Designed by : Dept. of Electrical & Electronics Engineering							
OBJECTIVES								
To study the analysis of systems using state space model								
To understand the concept of stability								
To familiarize the optimal control problem								
COURSE OUTCOMES (COs)								
CO1	Apply the knowledge of basic and advance control system for design of control systems.							
CO2	Understand and able to apply the concepts of state variable analysis for real time applications.							
CO3	To apply advanced control theory to practical engineering problems.							
CO4	To understand and apply nonlinear systems for real time applications.							
CO5	Analyze the concept of stability of nonlinear 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					
	CO3			M		H		
	CO4		H					
	CO5	H			H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I PROPERTIES OF TRANSFER FUNCTION

Impulse response matrices- poles & zeros of transfer function matrices critical frequencies resonance-steady state and dynamic response bandwidth-singular value, Analysis-multivariable Nyquist plots.

UNIT II **8**

REVIEW OF STATE MODEL FOR SYSTEMS

State transition matrix & its properties-free and forced response control ability and observability-kalman's Decomposition-Minimal realization.

UNIT III **10**

STATE FEEDBACK AND STATE ESTIMATORS

Single variable case-connection of state feedback and state estimators Compensation design-design concepts-realization of basic compensation-cascade compensation in time domain and frequency domain .

UNIT IV **11**

TYPES OF NON-LINEARITY

Typical examples-phase plane analysis-isoclines method-limit cycles Equation Linearization-Describing function-Describing function analysis of simple non linear systems.

UNIT V **9**

STABILITY CONCEPTS

Equilibrium points-BIBO & Asymptotic stability-direct method of liapnov-variable gradient method of generating liapnov functions-applications to non-linear problems-krasakovskils theorem on global asymptotic stability of non linear systems.

Total No. of Periods: 45

Text Books:

1. Gopal M. Modern control system theory, New age International pvt Ltd, 2002.

References:

1. Nagrath & Gopal, Control system engineering, Wiley & Sons, 1982.

2.Ogata K. 11, Modern control engineering, PHI, 1982.

3.Ogata K.H, State space analysis of control systems, PHI.

4.Tou.J.T. Modern control theory, McGraw hill.

MPE101	ANALYSES OF POWER CONVERTERS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES								
To understand and acquire knowledge about various power converter circuits and to prepare the students to analyze and design different power converter circuits.								
COURSE OUTCOMES (COs)								
CO1	Ability to analyze various single phase and three phase ac to dc converters power converter circuits and understand their applications.							
CO2	Identify basic requirements for power electronics dc to dc converters							
CO3	Analyze the operation of various AC Voltage controllers							
CO4	Understand the use of power converters in commercial and industrial applications.							
CO5	Use power electronic simulation packages for analyzing and designing power 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	a	b	c	d	e		
2	CO1		L	H				
	CO2	M				L		
	CO3		M					
	CO4	H			H			
	CO5			L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

AC TO DC CONVERTERS

9

Single phase and three phase bridge rectifiers half controlled and fully controlled converts with RL, RLE loads, freewheeling diodes. Dual converter, sequence control of converters. Inverter operation, input harmonics output ripple, smoothing inductance-power factor-effects of source inductance, overlap, inverter limit. Microprocessor based triggering for converters.

UNIT II

DC TO DC CONVERTERS

9

Principle of operation, choice of commutation circuit elements, step down and step up choppers, classification, voltage and current commutated choppers, effect of source inductance, filter circuits, multiphase-chopper, resonant converter triggering circuit

UNIT III

AC PHASE CONVERTER

9

Principle of phase control, single phase bi-directional controllers with R,L. and R-L loads 3-phase controllers, different configurations. Analysis with pure R and L loads.

UNIT IV

AC TO AC CONVERTERS

9

Principle of operation, single phase and three phase cycloconverters power circuit microprocessor based triggering circuit-harmonics –power factor.

UNIT – V

APPLICATION OF CONVERTERS

9

Converter and choppers dc drives AC voltage controller for lighting and speed control of fans, cycloconverter fed A/c drives.

TEXT BOOKS:

1. Rashid M.H. “Power Electronics circuit devices and Applications”, Prentice Hall India, New Delhi, 1995
2. Mohan N. Undeland and Robbins, “Power Electronics- Converters, Application and Design”, John Wiley and Sons. Inc., New York, 1995.

REFERENCES:

1. P.C. Sen, “Modern power Electronics” Wheeler publishing Co., first Edition, New Delhi-1998.

MPE102	ADVANCED SEMI CONDUCTOR DEVICES	L	T	P	C

		Total Contact Hours: 45			3	0	0	3
		Prerequisite:						
		Course Designed by : Department of Electrical and Electronics Engineering						
OBJECTIVES								
To introduce students to the physics of semiconductors and the inner working of semiconductor devices and to provide students the insight useful for understanding new semiconductor devices and technologies.								
COURSE OUTCOMES (COs)								
CO1		Study and analyze the switching devices and their performance.						
CO2		Understand and analyze the inner working of semiconductor p-n diodes, Schottky barrier diodes and new semiconductor devices						
CO3		Understand the details of operation of the advanced semiconductor electronic devices						
CO4		Understand operation principles and physics of IGBT and Power MOSFETs						
CO5		Design and analyze semiconductor devices for different 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		L		L	H		
	CO2	H	L	H		H		
	CO3	H	H	H	M			
	CO4	M	H	L	M	L		
	CO5	L	M			M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Introduction: Diodes, Thyristors, BJTs, MOSFETs, GTOs, IGBTs.- comparison of these a switching devices.

UNIT II POWER DIODES AND BJTs 9

V-I characteristics of power diodes –Scottky diode –Snubber design-switching characteristics of BJTs-Drive circuits for BJTs-safe operating area.

UNIT III Thyristors and GTOS 9

Physics of device operation and GTO's characteristics of thyristors and GTOs Ratings of Thyristors-Turn-on and Turn off mechanism of Thyristors –Protection circuits for thyristors and GTO's.

UNIT IV IGBTs and POWER MOSFETs 9

Device operation of Power MOSFET sand IGBT'S – V-I characteristics Switching characteristics of Power MOSFET S and IGBTs-Safe operating Area curve of power MOSFETS and IGBTs protection circuits for IGBTs.

UNIT V APPLICATIONS 9

Thyristor applications in Switched Mode power supplies UPS, Zero Voltage Switch, Integral Cycle and Arc welding.

Total periods: 45

REFERENCE BOOKS:

1. Kassakian J.G. et.at,-"Principles of power Electronics"- Addison Wesley
2. Murphy J. MD and Turbul G,- "Power Electronics control of AC Motors"- Pargamon Press oxford 1998.
3. Rashid M.H. Power Electronics circuits, Devices and Applications Prentice Hall India New Delhi 1995.

MPE103	ANALYSIS OF ELECTRICAL MACHINES				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Department of Electrical and Electronics Engineering							
OBJECTIVES								
To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.								
COURSE OUTCOMES (COs)								
CO1	Understand the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.							
CO2	Analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.							
CO3	Analyze theory of transformation of three phase variables to two phase variables.							
CO4	Analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.							
CO5	Analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/POs	a	b	c	d	e		
2	CO1	H						
	CO2				H			
	CO3	H		H				
	CO4		H	H	H	H		
	CO5	H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

Magnetic circuits, permanent magnet, stored magnetic energy, co-energy - force and torque in singly and doubly excited systems – machine windings and air gap mmf - winding inductances and voltage equations.

UNIT II

DC MACHINES 9

Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – Time domain block diagrams - solution of dynamic characteristic by Laplace transformation – digital computer simulation of permanent magnet and shunt d.c. machines.

UNIT III

REFERENCE FRAME THEORY 9

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference.

UNIT IV

INDUCTION MACHINES 9

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for load torque variations – digital computer simulation.

UNIT V

SYNCHRONOUS MACHINES 9

Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – analysis of dynamic performance for load torque variations – digital computer simulation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Paul C. Krause, Oleg Wasykczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010.

REFERENCES

1. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 2008.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, "Electric Machinery", Tata McGraw Hill, 5th Edition, 1992.

MPE104	SYSTEM DESIGN USING MICRO-CONTROLLERS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES								
Describe the basic architecture and addressing modes of a stored-program computer. Apply the principles of top down design to microcontroller software development								
COURSE OUTCOMES (COs)								
CO1	Understands types of computers & microcontrollers,							
CO2	Understands 8-Bit, 16- Bit & 32 Bit advanced Microcontrollers.							
CO3	Understands Real Time Applications of Microcontrollers.							
CO4	Understands RTOS for Microcontrollers.							
CO5	Design Hardware applications using Microcontrollers							
Mapping of Course Outcomes with 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			M			
	CO2	L	M					
	CO3			H				
	CO4	M				H		
	CO5				L			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

MICRO CONTROLLER RESOURCES 9

Role of micro – controllers – CPU register structure – addressing modes – family members – applications.

UNIT II

OVERVIEW OF 8051 9

Architectures of 8051 – Timers/counters – serial Interlace – Registers – Memory – Memory organization – input ports – o/p parts I/O H/W structures – Interrupts.

UNIT III

OVERVIEW OF M68HC 9

Configuring 68HCII – Intempts timers – Parallel I/o serial peripheral interface – A/O converters – wairs/stop modes

UNIT IV

INTEL 8096 STRUCTURE 9

Features of 8096 – Architecture of 8096-CPU section – I/o section – High Speed inputs – High speed o/p Interrupts – Timers Interrupt density Interval constraints I/o control status registers – reset circuitry – Ports.

UNIT V

SOFTWARE BUILDING BLOCKS / EXPANSION METHODS 9

Memory expansion methods real time control-PWN control-queues –tables – instruction set-programming

Total Periods: 45

REFERENCES

1. John B. Peatman, „Design with Micro-controller“, Mc-Graw Hill International.
2. John C. Roder „Using the M68HC11 Micro – controller

SEMESTER II

MPE201	ANALYSIS OF POWER INVERTERS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES To understand and acquire knowledge about various power semiconductor devices.								
COURSE OUTCOMES (COs)								
CO1	Analyze various single phase and three phase power inverters circuits and understand their applications.							
CO2	Identify basic requirements for Series inverters based design application.							
CO3	Develop skills to build, and troubleshoot Current source bridge inverter circuits.							
CO4	Understand the use of modern inverters, SMPS and UPS							
CO5	Understand the use of power converters in commercial and industrial 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	L				
	CO2	H				H		
	CO3		M					
	CO4		L	L				
	CO5				M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

INVERTERS 9

Single Phase and three phase voltage source and current source inverters need for feed back diodes in anti parallel with switches-configuration single phase voltage source inverter. Half and full bridge selection of switching frequency and switching device.

UNIT II

SCR BASED INVERTER 9

Series inverters: basic series inverter, modified series inverter, high frequency series inverter, three phase series inverter – design parallel inverter, single phase auxiliary commutated inverter: Mc Murray Bedford inverter.

UNIT III

SCR BASED INVERTER 9

Current source bridge inverter, analysis of single phase and three – phases auto sequential commutated current source inverter.

UNIT IV

MODERN INVERTERS 10

BJT/IGBT based modern high switching inverters, Need for output voltage control and Harmonics elimination, PWM inverters: principle of SMPS and UPS, resonant inverter: ZCS&ZVC concepts.

UNIT V

APPLICATION OF INVERTERS 8

VSI and CSI fed 3 – Phase induction motor drives

Total Periods: 45

TEXT BOOK:

1. G.K. Dubey Eta, “Thyristorised Power Controllers” New Age International Pvt., Ltd. New Delhi, 1996.

REFERENCE BOOKS:

1. Rashid MH, “Power Electronics Circuits Devices and Applications” Prentice Hall India Second Edition, New Delhi 1995

2. P.S. Bimbhra, "Power Electronics," Khanna Publications New Delhi 1996.

MPE202	SOLID STATE AC DRIVE				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES Understand the stable steady state operation and transient dynamics of motor-load system								
COURSE OUTCOMES (COs)								
CO1	Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory							
CO2	Apply the concepts of power electronics into real time problems.							
CO3	Application of drives to electrical engineering problems.							
CO4	Ability to understand the stable steady state operation and transient dynamics of motor-load system							
CO5	Learn characteristics and control of solid state AC motors 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	a	b	c	d	e		
2	CO1		L					
	CO2	H						
	CO3				H	L		
	CO4		H					
	CO5	L						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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 starting, 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

MPE203	SOLID STATE DC DRIVE				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES								
Understand the stable steady state operation and transient dynamics of motor-load system								
COURSE OUTCOMES (COs)								
CO1	Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory							
CO2	Application of drives to electrical engineering problems.							
CO3	Apply the concepts of power electronics into real time problems							
CO4	Learn characteristics and control of solid state DC motors drives.							
CO5	Learn digital control 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	a	b	c	d	e		
2	CO1				L			
	CO2	H		H				
	CO3		M					
	CO4					L		
	CO5	L			H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

REVIEW OF CONVENTIONAL DC DRIVES

12

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.

UNIT II

CONVERTER CONTROL OF DC MOTOR

12

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.

UNIT III

CHOPPER CONTROL OF DC MOTORS

12

Analysis of series and separately excited dc motor fed from different choppers, effect of saturation in series motor, CLC and TRC strategies, Microprocessor based firing circuit.

UNIT IV

DESIGN OF CONVERTER FED DC DRIVES

12

Speed loop, current loop, armature current reversal, digital controller and microprocessor based firing circuits, simulation.

UNIT V

INTELLIGENT CONTROLLER FOR DRIVES

12

Microcomputer implementation of control function fuzzy, neuro, fuzzy-neuro controllers.

Total Periods: 60

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. SUBHRAMANYAM. 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.

MPE204	SPECIAL ELECTRICAL MACHINES AND CONTROLLERS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by :							
OBJECTIVES To learn about the construction and working principle of special electrical machines								
COURSE OUTCOMES (COs)								
CO1	The ability to understand axial and radial air gap of Synchronous Reluctance Motors							
CO2	The ability to understand open loop control, closed loop control of stepping motor.							
CO3	The ability to understand microprocessor based controller of Switched Reluctance Motor							
CO4	The ability to understand EMF equation, Torque – Speed characteristics Controllers Of Permanent Magnet Brushless Dc Motors							
CO5	The ability to understand EMF equation, Torque – Speed characteristics Controllers of Permanent Magnet Synchronous Motors							
Mapping of Course Outcomes with 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							
	CO2	M		M	L			
	CO3					M		
	CO4		L					
	CO5			L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features-types-axial and radial air gap motors-operating principle-reluctant torque-phasor diagram-characteristics-Vernier motor.

UNIT II

STEPPING MOTORS 11

Constructional features of operation, modes of excitation torque production invariable Reluctance (VR) stepping, motor, Dynamic Characteristics, Drives systems and circuits for open loop control, closed loop control of stepping motor.

UNIT III

SWITCHED RELUCTANCE MOTOR 11

Constructional features, principle of operation, torque equation, power controller's characteristics and controllers, characteristics and control microprocessor based controller.

UNIT IV

PERMANENT MAGNET BRUSHLESS DC MOTORS 12

Communication in DC motors, difference between mechanical and electronics communications, Hall sensors, optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives and emf equation, Torque – Speed characteristics Controllers – Microprocessors based controller.

UNIT V

PERMANENT MAGNET SYNCHRONOUS MOTORS 11

Principle of operation, EMF, power input and torque expressions, Phasor diagram power controllers, Torque – speed characteristics, self control Vector Control, Current control schemes.

Total Periods: 45

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.

MPE205		POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS			L	T	P	C
		Total Contact Hours:45			3	0	0	3
		Prerequisite:						
		Course Designed by :						
OBJECTIVES To learn about the impacts of renewable energy generation on environment								
COURSE OUTCOMES (COs)								
CO1	The ability to understand different renewable energy resources : Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems							
CO2	The ability to understand fundamentals of IG, PMSG, SCIG and DFIG.							
CO3	The ability to understand Principle of Operation of solar and wind power systems							
CO4	The ability to understand Grid Connection Issues							
CO5	The ability to understand Hybrid Systems- 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		
2	CO1					M		
	CO2	M	H	L				
	CO3							
	CO4	H	M		M			
	CO5							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I **9**

INTRODUCTION

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 **9**

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

Review of reference theory fundamentals – Principle of Operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT-III **9**

POWER CONVERTERS

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 **9**

ANALYSIS OF WIND AND PV SYSTEMS

Stand alone 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 **9**

HYBRID RENEWABLE ENERGY SYSTEMS

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.

ELECTIVES
PROGRAMME ELECTIVE (CE) – I

MPE001	WIND ENERGY CONVERSION SYSTEMS					L	T	P	C
	Total Contact Hours: 45					3	0	0	3
	Prerequisite: Electrical Machines, Power system								
	Course Designed by : Dept of Electrical & Electronics Engineering								
OBJECTIVES									
To understand and analyze the present and future energy demand of world and nation. Techniques to exploit the available renewable energy resources such as, wind power effectively.									
COURSE OUTCOMES (COs)									
CO1	To understand and analyse the basic schemes and components of wind energy conversion system.								
CO2	To understand and analyse the design concepts of wind turbines								
CO3	To understand the concepts of fixed speed wind energy conversion systems								
CO4	To understand the concepts of variable speed, wind energy conversion systems								
CO5	To analyze the grid integration 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			
2	CO1	M	M	L	M	L			
	CO2	H	M	L	H	L			
	CO3	M	M	L	M	L			
	CO4	M	H	L	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT-I

INTRODUCTION TO WECS 9

Components of WECS-Schemes of WECS-Power obtained from wind- simple momentum theory- power coefficient- Sabinin's theory- Aerodynamic s of wind turbine.

UNIT-II

WIND TURBINES 9

HAWT-VAWT-Power developed –Thrust – Efficiency- Rotor selection – Rotor design considerations- Tip Speed ratio- No of Blades- Blade profile-Power Regulation-Yaw control- Pitch angle control-stall control- Schemes for maximum power extraction.

UNIT-III 9

FIXED SPEED SYSTEMS

Generating Systems- Constant speed constant frequency systems- Choice of Generators- Deciding factors- synchronous Generator- squirrel cage induction Generator- Model Wind turbine rotor-Drive Train Model- Generator model for steady state and Transient Stability analysis.

UNIT-IV 9

VARIABLE SPEED SYSTEMS

Need of variable speed systems- Power-Wind speed Characteristics –Variable speed constant frequency systems synchronous generator- DFIG-PMSG-Variable speed generators modeling- Variable speed variable frequency schemes.

UNIT-V 9

GRID CONNECTED SYSTEMS

Stand alone and Grid connected WECS system – Grid connection Issues- Machine side & Grid Side controllers- WECS in various countries.

Total Periods: 45

TEXT BOOKS:

1. L.L.Freris "Wind Energy Conversion Systems", Prentice Hall,1990.
2. Ion Boldea, "Variable Speed Generators", Taylor & Francis group,2006.

REFERENCE

1. E.W.Golding "The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
2. S.Heir "Grid Integration of WECS", Wiley 1998.
3. L.L.Freris "Wind Energy Conversion Systems", Prentice Hall,1990.
4. Ion Boldea, "Variable Speed Generators", Taylor & Francis group,2006.
5. E.W.Golding "The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
5. S.Heir "Grid Integration of WECS", Wiley 1998.

MPE002	HIGH VOLTAGE DC TRANSMISSION				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Power Electronics, High Voltage Engineering.							
	Course Designed by : Dept of Electrical & Electronics Engineering							
OBJECTIVES								
To mould the students to acquire knowledge about HVDC Transmission systems								
COURSE OUTCOMES (COs)								
CO1	To get an idea about modern trends in HVDC Transmission and its application							
CO2	To complete analysis of harmonics and basis of protection for HVDC Systems.							
CO3	To understand the power flow control on HVDC Transmission system							
CO4	To Understand the Operation of the controller for HVDC in worst and normal operations							
CO5	To understand the complete operation of HVDC Converter stations							
Mapping of Course Outcomes with 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		
	CO2	H	H	H	M	M		
	CO3	H	M	M	M			
	CO4	H	M		M			
	CO5		M		M	H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I	INTRODUCTION	9
Comparison of AC and DC transmission-Types of DC links-components of HVDC systems principal application of DC transmission-merits and demerit of DC transmission-modern trends in DC transmission		
UNIT II	THYRISTOR CONVERTORS AND ANALYSIS	9
Thyristors-switching and steady state characteristics-valve firing-recent trends-pulse number converter configuration-analysis of Graetz circuit-converter bridge characteristics pulse converter.		
UNIT III	HVDC SYSTEM CONTROL	9
Desired features of control-converter control characteristics-constant current control extinction angle control-system control-firing angle control Reactive power control		
UNIT IV	STABILITY ANALYSIS	9
Modeling of converter-DC network and synchronous generator-solution methodology-transient stability improvement using DC link control voltage stability in AC-DC systems control.		
UNIT V	POWER MODULATION AND HARMONICS	9
Power modulation controls, reactive power modulation. Characteristic harmonics-troubles due to harmonics-harmonic filters.		

Total Periods:45

REFERENCES:

1. HVDC Power transmission system-Padiyar K.R. wiley Eastern Pvt. Ltd. 1980.
2. Direct current Transmission-Kimbark, Vol 1., John Wiley, New York, 1971.
3. Computer Modeling of electric Power Systems-Arriliaga J. and Arnald C.P. & Parker B.J., John wiley& Sons, 1983.

MPE003	DESIGN OF INTELLIGENT CONTROLLERS				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Neural Network and Fuzzy Logic							
	Course Designed by : Department of Electrical and Electronics Engineering							
OBJECTIVES: To master the complete idea of design of Intelligent Controllers by learning planning strategies, Reliability analysis and distribution protection.								
COURSE OUTCOMES (COs)								
CO1	To learn the structure , operation and design of Intelligent Controllers							
CO2	To learn the planning strategies in the design of Intelligent Controllers							
CO3	To have a clear understanding of reliability analysis.							
CO4	To learn the voltage control and its advancements in distribution							
CO5	To learn the protection of feeders.							
Mapping of Course Outcomes with 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	L	M		H	L		
	CO3	L	M	M	H			
	CO4		H		H	H		
	CO5	L		L		H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I	INTRODUCTION	9
Model based controllers – adaptive controllers – model reference adaptive control –model identification adaptive controllers – optimal control – predictive control		
UNIT II	ARTIFICIAL INTELLIGENT BASED CONTROLLERS	9
Natural language system – perception system for vision speech and touch – expert or knowledge-representation – inference strategy – expert controller		
UNIT III	FUZZY LOGIC SYSTEM	9
Introduction – fuzzy controller - fuzzyfier – knowledge base- defuzzyfier- fuzzy logic tools – fuzzy logic controller		
UNIT IV	ARTIFICIAL NEURAL NETWORK	9
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.		
UNIT V	APPLICATION OF FLC AND NEURAL NETWORKS	9
Non – Linear fuzzy control – PID – with FLC – sliding mode FLC – adaptive – fuzzy control application – Case studies		

Total periods: 45

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Nelson, Morgan, “Artificial Neural Networks: Electronic implementation”- IEEE Computer Society Press, USA1990.

MPE004	MICRO PROCESSORS & MICROCONTROLLER APPLICATION IN POWER ELECTRONICS				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by :Department of Electrical and Electronics Engineering							
OBJECTIVES								
To learn the basic architecture and addressing modes of microprocessor and microcontroller and to apply the principles to Power Electronic Applications.								
COURSE OUTCOMES (COs)								
CO1	Have knowledge on the types of computers, microcontrollers and microprocessors.							
CO2	Interface microcontrollers through external circuit interface to a variety of sensors and actuators.							
CO3	Describe different types of memory used in microcontroller systems and typical I/O interface and to discuss timing issues							
CO4	Understand the architecture and use of various on-chip peripherals of microcontroller and Develop algorithms for various control system blocks for power converters.							
CO5	Develop themselves in interfacing microcontrollers with power electronics drive and Selection of drives system for particular 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		
	CO2				L	H		
	CO3	H	M		L	H		
	CO4	H			L			
	CO5	L	L	H	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Architecture and programming of 8085, 8086, 8096 A/D and D/A converters- Interfacing of 8252, 8255 and other important interfacing ICs.

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 commutation inverters, types of pulse with modulation techniques, their implementation, using Microprocessors

Importance of measurement and sensing in closed loop control, measure of voltage current, speed power and power factor using microprocessors / micro controllers, implementation of various types of controllers using microprocessors/micro-controllers.

Static excitation of synchronous generators, solid state tap-changers for transformers UPS systems, induction motors.

Firing scheme to the control of DC driven induction motor, synchronous motor and stepper motor.

TEXT BOOKS:

1. Gaonkar. RS-“Microprocessor Architecture, Programming and Application with 8080/8085
Wiley Easter Limited”- New Delhi 1991

1. Hall D.V- "Microprocessors and interfacing McGraw Hill publishing company"- New Delhi 1986
2. John B. Peatman-"Design with microcontrollers"- McGraw Hill international Singapore 1989

PROFESSIONAL ELECTIVE (CE) – II

MPE005	POWER QUALITY				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Electrical & Electronics Engineering							
OBJECTIVES								
Understand the various power quality phenomena their origin and monitoring and mitigation methods. Understand the effects of various power quality phenomena on various equipment.								
COURSE OUTCOMES (COs)								
CO1	Able to know the severity of power quality problems in distribution system							
CO2	Able to understand the analysis of single phase and three phase system							
CO3	Able to Conventional load compensation methods							
CO4	Able to understand the concepts of load compensation.							
CO5	Understanding the basics 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	a	b	c	d	e		
2	CO1			M	H			
	CO2	H						
	CO3					H		
	CO4	H			H			
	CO5		H	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

INTRODUCTION

9

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, Non linear 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

Single phase linear and non linear 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 non linear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III

CONVENTIONAL LOAD COMPENSATION METHODS

9

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

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

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

Total No of periods: 45

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. Arrillaga
5. Power Electronic Converter Harmonics –Derek A. Paice.

MPE006	FLEXIBLE AC TRANSMISSION SYSTEM				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by :Department of Electrical and Electronics Engineering							
OBJECTIVES								
To understand the various aspects of Flexible AC Transmission Systems, the FACTS devices, their design, principle of operation and the mode of compensation								
COURSE OUTCOMES (COs)								
CO1	The ability to understand the working principle of various devices like Resonance damper, Thyristor controlled series capacitor, static condenser and phase angle regulator.							
CO2	The ability to understand the modelling and control of thyristor controlled series Compensators.							
CO3	The ability to understand how to control and Implementation of power flow control using conventional thyristor.							
CO4	The ability to understand Implementation of power flow control using conventional Thyristor.							
CO5	The ability to understand various types of compensation 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		
2	CO1	H		H		H		
	CO2	H	H		M	H		
	CO3		H		M			
	CO4	M	M	L		H		
	CO5	H	L	L	H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				✓				

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

UNIT I INTRODUCTION 9

FACTS-A toolkit, basic concepts of static VAR compensator, Resonance damper, Thyristor controlled series capacitor, static condenser, phase angle regulator, and other controllers.

UNIT II SERIES COMPENSATION SCHEMES 9

Sub-synchronous resonance, torsional interaction, torsional torque, compensation of conventional, ASC NHG damping schemes, modelling and control of thyristor controlled series compensators.

UNIT III UNIFIED POWER FLOW CONTROLLERS 9

Introduction, Implementation of power flow control using conventional thyristor, unified power flow concept, implementation of unified power flow controller.

UNIT IV DESIGN OF FACTS CONTROLLERS 9

Approximate multi-model decomposition, variable structures FACTS controllers for power system transient stability, Non-linear variable-structure control, variable-structures series capacitor control, variable-structure resistor control.

UNIT V STATIC VAR COMPENSATION 9

Basic concepts, Thyristor controlled reactor (TCR)- Thyristor switched reactor (TSR)- Thyristor switched capacitor (TSC)- Saturated Reactor (SR) and Fixed Capacitor (FC)

Total Periods: 45

References:

1. Narin G. Hingorani-“Flexible AC Transmission”-IEEE Spectrum April 1993, pp40-45.
2. Narin G. Hingorani-“High Power electronics and Flexible AC Transmission Systems”-IEEE power Engineering Review, 1998.
3. Narin G. Hingorani-“Power Electronics in Electric Utilities Role of power electronics in future power systems”-Proceedings of IEEE, Vol 76 No.4 April 1998.
4. Einar V. Larsen, Juan J. Sanchez-Gasca, Joe H. Chow, “Concepts for design of FACTS controllers to damp power swing”, IEEE Trans on power systems, Vol 10 No2 May 1995
5. Gyugyi L “Unified power flow controller concepts for Flexible AC transmission”-IEEE proceedings, Vol 139 No.4. July 1992

MPE007	MEMS TECHNOLOGY				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by :Department of Electrical and Electronics Engineering							
OBJECTIVES								
To understand the principle of operation, various fabrication techniques and the application areas of MEMS Devices.								
COURSE OUTCOMES (COs)								
CO1	Propose, plan and develop MEMS devices and applications							
CO2	Understand multi domain problems: thermal, fluidic, mechanical and electrical							
CO3	Design a fabrication process of a MEMS device							
CO4	Extend the principles of micro fabrication to the development of micromechanical devices and the design of Microsystems							
CO5	Analyze and model the behavior of micro electromechanical devices and systems.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/POs	a	b	c	d	e		
2	CO1	L	H		L			
	CO2	H		M	L	H		
	CO3	H	L	M		H		
	CO4	M	L	H	M	L		
	CO5		M		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Overview of Micro fabrication – Silicon and other material based fabrication processes- Concepts: conductivity of Semiconductors – Crystal planes and orientation- Stress and Strain- Flexural beam bending analysis- torsional deflections- Intrinsic Stress- resonant frequency and quality factor

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and Actuators – applications.

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors- Applications.

Piezoelectric effect- cantilever piezoelectric actuator model- Properties of piezoelectric materials- Applications.

Piezoresistive sensors, Magnetic actuation, Micro fluids applications, Medical applications, Optical MEMS.

REFERENCE BOOKS

1. Chang Liu, “Fundamentals of MEMS”-Pearson International Edition,2006.
2. Marc Madou, “Fundamentals of Micro fabrication”,-CRC Press,1997.
3. Boston, “Micro machined Transducers sourcebook”,-WCB McGraw Hill,1998.
- 4.M.H.Bao, “Micromechanical transducers: Pressure sensors, Accelerometers and Gyroscopes”,-Elsevier, Newyork,2000.

MPE008	NEURAL NETWORKS AND FUZZY LOGIC CONTROL				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Digital Electronics, Basics of set theory							
	Course Designed by : Dept of Electrical & Electronics Engineering							
OBJECTIVES								
To expose the students to the concepts of fuzzy sets and operations. To provide adequate knowledge about feed forward and back propagation neural networks. To have sound knowledge about neuron models, learning algorithms and applications.								
COURSE OUTCOMES (COs)								
CO1	To understand and analyze the fuzzy sets and fuzzy logic.							
CO2	To understand the fuzzy notations, fuzzy controllers and algorithms							
CO3	To understand and analyze artificial neural network architecture and algorithms							
CO4	To study about self organizing maps, adaptive resonance theory and network architecture							
CO5	To apply the fuzzy and neural network concepts in real time applications image processing control system and signal processing.							
Mapping of Course Outcomes with 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	L	L	M	M	L		
	CO2	M	M	M	M	L		
	CO3	M	M	M	M	L		
	CO4	M	M	L	M	L		
	CO5	H	H	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT – I **9**

FUZZY SETS AND FUZZY SYSTEMS

Fuzzy sets – properties of fuzzy sets – representation of fuzzy sets – operations of fuzzy sets – fuzzy relation – relation composition. Fuzzy system– Rule based fuzzy system – linguistic model – Singleton model - Relational model – Takagi – Sugeno model – Dynamic fuzzy systems.

UNIT – II **9**

FUZZY CLUSTERING AND FUZZY CONTROL

Basic notations – hard and fuzzy partitions – fuzzy C- means clustering – Gustafson – Kessel algorithm. Knowledge based fuzzy control – Motivation for fuzzy control – fuzzy control as a parameterization of controllers non-linearities – mamadani controller – Takasi - sugeno controller – fuzzy supervisory control.

UNIT – III **9**

ARTIFICIAL NEURAL NETWORKS

Biological neuron – artificial neuron – neuron network architecture – learning – Multilayer neural network – radial based function network. Perception – multilayer perception architecture-Back propagation algorithm and its variant.

UNIT – IV **9**

NETWORK ARCHITECTURES

Hopfield network-kohonen-Self organizing maps – ART I and II, Grossberg nets recurrent network – reinforcement learning.

UNIT – V **9**

CONTROL BASED ON FUZZY AND NEURAL MODELS

Applications of fuzzy logic and neural network to measurement, control, signal processing and image processing.

Total No of Periods: 45

TEXT BOOKS:

1. Laurance Fausett, "Fundamentals of Neural Network", Prentice Hall, Englewood Cliffs N-S, 1992.
2. Jacek M. Zurava, Introduction to Artificial neural system, Jiaco publishing House, Mumbai. 1997.

REFERENCE:

1. Draiankor D. Hellendron H. Reinfrank. M. An introduction to fuzzy control Narosa publishing House. New Delhi 1996.
2. Timothy J- Ross. Fuzzy logic with engineering applications. International editions.

PROFESSIONAL ELECTIVE (CE) – III

MPE009	INDUSTRIAL APPLICATIONS OF ELECTRICAL DRIVES			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Power Electronics						
	Course Designed by :Department of Electrical and Electronics Engineering						
OBJECTIVES							
To understand and examine various motor terminologies, their applications and their control procedure							
COURSE OUTCOMES (COs)							
CO1	To know the functions and applications of AC drives and DC drives.						
CO2	Describe the functioning of electric drives						
CO3	Obtain the rating and heating of motors employed for various applications						
CO4	Describe the various applications of drives						
CO5	Analyze the converter based 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	a	b	c	d	e	
2	CO1	L	H		L		
	CO2	H		M	L	H	
	CO3	H	L	L		H	
	CO4	M	L	L	M	L	
	CO5		M		M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
				√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT-I INTRODUCTION**9**

Requirements of an adjustable speed drive – Forms of drive motors – AC drives versus DC drives – Trends in drive Technology

UNIT-II DYNAMICS OF ELECTRIC DRIVES**9**

Introduction – Classification electric drive – Basic elements of an Electric drive – Dynamic conditions of a drive system – Stability condition of electric drive – Selection of motors – Characteristics of motors for variable speed drives.

UNIT-III RATING AND HEATING OF MOTORS**9**

Requirements of a drive motor –Power losses and heating of electric motors – Heating and cooling curves of an electric power – classes of duty – selection of design ruling motor.

UNIT-IV DRIVES FOR SPECIFIC APPLICATIONS**9**

Introduction - Drives and motors for textile mills – Steel rolling mills – Cranes and Hoist drives –Cement mills – Sugar mills – Machine tools – Paper mills – Coal mines – Centrifugal mills – Turbo compressors – Traction. A review of thyristorised DC and AC drives.

UNIT-V HIGH POWER INDUSTRIAL DRIVES**9**

Introduction – Drive rating classification with speed and power ratings – Versatility of DC drive and Limitations at large power and high speed - Thyristorised of DC drive and Limitations at large power and induction motor drives at high power level – a short survey of the evaluation of large power drive – Synchronous motor drives – Load commutated converter motor fed from a CSI – Operating modes of motor – Converter – Motor plus converter – implementation of the system – converter for high power – cooling system – fault tolerant design – Reduction of line harmonics and improvement of line power factor – Applications.

Total Periods: 45**REFERENCE BOOKS:**

1. Vedam Subrahmanyam, “Electric Drives, Concepts and Applications” , TMH, 1994
2. Richard M. Crowder, “Electric Drives and Their Controls”, Clarendon, Oxford 1995

MPE010	SCADA SYSTEM AND APPLICATIONS MANAGEMENT				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Power Electronics							
	Course Designed by :Department of Electrical and Electronics Engineering							
OBJECTIVES								
• To understand about the SCADA system components and SCADA communication protocols • To provide knowledge about SCADA applications in power system								
COURSE OUTCOMES (COs)								
CO1	know the basic SCADA Functional requirements and Applications							
CO2	Understand the SCADA system components							
CO3	Describe the SCADA communication							
CO4	Analyze the SCADA monitoring and control							
CO5	Analyze the SCADA applications 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	a	b	c	d	e		
2	CO1	H	H		H	M		
	CO2		H			M		
	CO3			H				
	CO4				H			
	CO5		H			H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

INTRODUCTION TO SCADA

9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II

SCADA SYSTEM COMPONENTS

9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III

SCADA COMMUNICATION

9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV

SCADA MONITORING AND CONTROL

9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnect control.

UNIT V

SCADA APPLICATIONS IN POWER SYSTEM

9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA, 2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK, 2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
5. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999
6. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001

Total Periods: 45

MPE011	SMART GRID				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: FACTS, Power Generation Systems, Transmission and Distribution							
	Course Designed by : Dept of Electrical & Electronics Engineering							
OBJECTIVES								
• To provide students with a working knowledge of fundamentals, design, analysis, and development of Smart Grid, from the basic concepts of power systems to the inherent elements of computational intelligence, communication technology and decision support system.								
COURSE OUTCOMES (COs)								
CO1	able toUnderstand the fundamental element of the smart grid,							
CO2	able toUnderstand the fundamental structure of the power grid							
CO3	use simulation tools such as Matlab and Paladin, for power flow analysis, optimization and state estimation							
CO4	understand communication, networking, and sensing technologies involved with the smart grid							
CO5	Develop computational techniques involved with the smart grid (decision support tools 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	a	b	c	d	e		
2	CO1	M						
	CO2	H	H	H	H	M		
	CO3	M	M		M	H		
	CO4	M	M	H	M	M		
	CO5	H	H	M	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				

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

UNIT I INTRODUCTION TO SMART GRID

9

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

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).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE

9

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

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 FOR SMART GRID APPLICATIONS

9

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.

Total Periods: 45 Periods

REFERENCES:

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and
3. Improved Power Grid: A Survey", IEEE Transaction on Smart Grids,
4. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.
5. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,
6. "Smart Grid: Technology and Applications", Wiley.

MPE012		SMPS AND UPS				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite:							
		Course Designed by :Department of Electrical and Electronics Engineering							
OBJECTIVES									
To acquire knowledge in the design, principle and operation of Switch Mode Power Supplies and Uninterrupted Power Supplies									
COURSE OUTCOMES (COs)									
CO1		Understand conceptual knowledge in modern power electronic converters and its applications in electric power utility							
CO2		Describe switching mode power converters							
CO3		Design the resonant converter							
CO4		Understand the operation of DC-AC Converters							
CO5		Describe the operation of power conditioners, UPS& filters							
Mapping of Course Outcomes with 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	L		M	H	L			
	CO3	H		L					
	CO4	L	L	H	M	L			
	CO5	M	M		M	H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

9

UNIT II SWITCHING MODE POWER CONVERTERS

9

UNIT III RESONANT CONVERTERS

9

UNIT IV DC-AC CONVERTERS

9

UNIT V POWER CONDITIONERS, UPS & FILTERS

9

Total Periods: 45

1. M.H. Rashid – “Power Electronics handbook”, Elsevier Publication, 2001.
2. Kjeld Thorborg, “Power Electronics – In theory and Practice”, Overseas Press, First Indian Edition 2005.
3. Philip T Krein, “Elements of Power Electronics”, Oxford University Press
4. Ned Mohan, Tore.M.Undeland, William.P.Robbins, “Power Electronics converters, Applications and design”- Third Edition- John Wiley and Sons- 2006
5. M.H. Rashid – “Power Electronics circuits, devices and applications”- Third edition-Prentice Hall of India New Delhi, 2007.

OPEN ELECTIVE (OE) – I

MPE013	SOLAR AND ENERGY STORAGE SYSTEMS			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite: Basics of Renewable Energy Sources						
	Course Designed by : Dept. of Electrical & Electronics Engineering						
OBJECTIVES							
To Study about solar modules and PV system design and their applications , grid connected systems and about different energy storage systems							
COURSE OUTCOMES (COs)							
CO1	To understand the Characteristics of sunlight and solar cells						
CO2	To describe the stand alone PV system						
CO3	To understand Grid connected PV systems						
CO4	To know Energy storage systems						
CO5	To describe the Applications of solar 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			M	H	
	CO2		H				
	CO3	H		M		H	
	CO4		H		H		
	CO5	H		M		H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT I**INTRODUCTION****9**

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection.

UNIT II**9****STAND ALONE PV SYSTEM**

Solar modules – storage systems – power conditioning and regulation - protection – stand alone PV systems design – sizing.

UNIT III**9****GRID CONNECTED PV SYSTEMS**

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.

UNIT IV**9****ENERGY STORAGE SYSTEMS**

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage

UNIT V**9****APPLICATIONS**

Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

Total No of Periods : 45

References:

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progenesa,1994.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.
3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
4. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

MPE014	COMPUTER NETWORK ENGINEERING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Nil							
	Course Designed by : Department of Computer Science Engineering							
OBJECTIVES								
To master the concept of Computer Network Engineering and their usage in various Power Electronics applications.								
COURSE OUTCOMES (COs)								
CO1	To learn the basic concepts of expert systems and their applications							
CO2	To learn the concepts of artificial intelligence systems and their applications							
CO3	To master the programming in Computer Network Engineering							
CO4	To use and analyze Computer Network concepts for Power electronics problems							
CO5	To program and to trouble shoot the Computer Network based 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		
2	CO1	H			H	H		
	CO2	H			H	L		
	CO3	H	M		M	M		
	CO4		H	L		H		
	CO5			L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I	PROTOCOLS AND ARCHITECTURES	9
Protocols – layered approach – OSI Model – Hierarchical Approach –Bus / Tree Topology – Ring topology Medium access protocols: Aloha & CSMA/CD – IEEE802, 803 standards		
UNIT II	NETWORK ACCESS PROTOCOL & INTERNETWORKING	9
Circuits switched Network access – packet switched network access- Broadcast network access principles of internetworking – Bridges, Gateways – Internet protocols - Internet protocol versions.		
UNIT III	TRANSPORT PROTOCOL & ROUTING TECHNIQUES	9
Transport services & Protocol mechanisms – TCP- UDP – Comparison of TCP & UDP Overview of routing techniques		
UNIT IV	PRESENTATION / APPLICATION PROTOCOLS	9
File transfer protocols – World Wide Web – Electronic mail – Overview of ISDN-ISDN protocols -Cryptography.		
UNIT V	NETWORK MANAGEMENT	9
Architecture of network management – Congestion control algorithms – Network Security – DES Algorithm –RSA Algorithm Signature – Authentication & Certificates.		

Total periods: 45

Reference Books:

1. Stallings, “Data and Computer Communication” Maxwell and Macmillan, 1998
2. Andrew Tannenbaum S, “Computer Networks” 3rd Edition prentice Hall of India, 1997.
3. Stalling, “Computer Communication Architecture, Protocols and Standards”, IEEE computer society 1987
4. Kemel Texpian A.S. “Communication Network Management” Prentice Hall, 1992
5. Uyters Black , “Network Management Standards”, McGraw Hill 1995
6. Commer and Stevans “Internetworking with TCP / IP Vol.III: Client server programming and applications”, Prentice Hall USA, 1994.

MPE015	DIGITAL SIGNAL PROCESSING					L	T	P	C
	Total Contact Hours:					3	0	0	3
	Prerequisite:								
	Course Designed by : Department of Electronics and Communication Engineering								
OBJECTIVES To develop skills for analyzing and synthesizing algorithms and systems that process discrete time signals, with emphasis on realization and implementation.									
COURSE OUTCOMES (COs)									
CO1	Represent discrete-time signals analytically and visualize them in the time domain.								
CO2	Understand the meaning and implications of the properties of systems and signals.								
CO3	Understand the Transform domain and its significance and problems related to computational complexity.								
CO4	Be able to specify and design any digital filters using MATLAB.								
CO5	Understand programmable DSP chips & 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		L	L					
	CO2	H				M			
	CO3		M	H					
	CO4			H					
	CO5	H			L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I**DISCRETE TIME SIGNALS AND SYSTEMS****9**

Periodic and pulse signals – examples of sequence – pulse step, impulse, ramp, sine and exponential – differential equations – linear time invariant – stability, causality – DT systems – time domain analysis.

UNIT II**TRANSFORM****9**

Z-transform and its properties – convolution – inverse Z-transform-discrete Fourier series – properties – sampling the Z-transform – discrete Fourier transform – properties for frequency domain analysis linear convolution using discrete Fourier transform overlap add method, overlap save method.

UNIT III**FAST FOURIER TRANSFORM (FFT)****9**

Introduction to Radix 2 FFT's – decimation in time FFT algorithm – decimation in frequency FFT algorithm – computing inverse DFT using FFT – Introduction to Radix 4 FFT's decimation in time FFT algorithm – decimation in frequency FFT

UNIT IV**IIR AND FIR FILTER DESIGN****12**

Classification – reliability constraints – IIR design – bilinear transform method – impulse invariant method step invariance method FIR design Fourier series method window function method – triangular window – rectangular window – hamming window – hanning window – keiser window

UNIT V**PROGRAMMABLE DSP CHIPS & APPLICATIONS****6**

Architecture and features of TMS320C26 and ADSP 2181 signal processing chips. Introduction to stenography – image processing.

Total Periods: 45**Text Books**

1. Oppenheim A.V and Schacter R.S. "Discrete Time Signal Processing" Prentice hall NJ, 1980.
2. Proakis J.G. and Manolakis D.G. "Introduction to Digital Signal Processing" Maxwell McWilliams International Edition London 1989.

References:

1. Stanley W.D. "Digital Signal Processing" Reston Publishing House 1989.

2. Sanjit K. Mitra “Digital Signal Processing- a Computer based approach” Tata McGraw Hill Publishing Co., 2001.
3. Antonia A “Digital Filters Analysis & Design” Tata McGraw Hill Publishing Co., New Delhi 1998.

MST070		RESEARCH METHODOLOGY			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Professional Courses						
		Course Designed by :Department of civil						
OBJECTIVES To know the various types of Formulation of Research Task,modeling and simulation, analysis of reports and report writing.								
COURSE OUTCOMES (COs)								
CO1		To understand the basic concept ofFormulation of Research Task.						
CO2		To have knowledge about mathematical modeling and simulation						
CO3		To understand experimental modeling.						
CO4		To know about of analysis of report.						
CO5		To know about of concept of report writing.						
Mapping of Course Outcomes with 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	M	M					
	CO2	H	M		L			
	CO3	H	M					
	CO4	M	M		L	L		
	CO5	M	M	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I RESEARCH CONCEPTS**9**

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT-II MATHEMATICAL MODELING AND SIMULATION**9**

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT-III EXPERIMENTAL MODELING**9**

Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT-IV ANALYSIS OF RESULTS**9**

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT-V REPORT WRITING**9**

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

Total No. of Periods: 45**TEXT BOOKS**

1. Willktsion K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, „Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovsky, „Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CURRICULUM AND SYLLABUS (R2015)**CHOICE BASED CREDIT SYSTEM****M.TECH - POWER SYSTEMS****(FULL TIME)****I – IV SEMESTERS**

SEMESTER I						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MMA111	PM	Applied Mathematics	3	2	0	4
MPS101	PC	Power Systems Analysis	3	0	0	3
MPS102	PC	Power System Operation & Control	3	0	0	3
MIC105	PC	Advanced Control Theory	3	0	0	3
MPS1E1	PE	Professional Elective – I	3	0	0	3
MPS1E2	PE	Professional Elective – II	3	0	0	3
Total Number of Contact Hours = 20 Total Number of Credits= 19						

SEMESTER II						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MPS201	PC	Power Systems Dynamics	3	0	0	3
MPS202	PC	Power Systems Transients	3	0	0	3
MPS203	PC	High Voltage DC Transmission	3	0	0	3
MPS2E3	PE	Professional Elective – III	3	0	0	3
MPS2E4	PE	Professional Elective – IV	3	0	0	3

PRACTICAL						
MPS2L1	PC	Power System simulation Lab	0	0	4	2
Total Number of Contact Hours = 19Total Number of Credits= 17						

SEMESTER – III						
Course Code	Category	Course Title	L	T	P	C
THEORY						
MPS301	PC	Power System Protection	3	2	0	4
MPS3E5	PE	ProfessionalElective – V	3	0	0	3
MPS3E6	OE	Open Elective – I	3	0	0	3
PRACTICAL						
MPS3P1	PR	Project Work Phase – I	0	0	12	6
Total Number of Contact Hours = 23 Total Number of Credits= 16						

SEMESTER – IV						
Course Code	Category	Course Title	L	T	P	C
PRACTICAL						
MPS4P2	PR	Project Work Phase – I	0	0	24	12
Total Number of Contact Hours = 24Total Number of Credits=12						

Total No. of Credits – 64

LIST OF ELECTIVES

S.No	Sub code	Subject Name	L	T	P	C

PROFESSIONAL ELECTIVE (PE) – I						
1.	MPS001	Special Electrical Machines & Controllers	3	0	0	3
2.	MPS002	Electrical Distribution System	3	0	0	3
3.	MPS003	Power System Stability	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – II						
1.	MPS004	Power Quality	3	0	0	3
2.	MPS005	Power System planning and Reliability	3	0	0	3
3.	MPS006	Restructured Power System	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – III						
1	MPS007	High Voltage Engineering	3	0	0	3
2	MPS008	Energy Management and Auditing	3	0	0	3
3	MPS009	Computer methods for Power System Analysis	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – IV						
1	MPS010	Wind Energy Conversion Systems	3	0	0	3
2	MPS011	FACTS Controllers	3	0	0	3
3	MPS012	Distributed Generation and Microgrid	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – V						
1	MPS013	Artificial Intelligence Applications to Power Systems	3	0	0	3
2	MPS014	Neural networks and Fuzzy logic control	3	0	0	3
3	MPS015	Smart Grid	3	0	0	3
OPEN ELECTIVE (OE) – I						
1	MPS016	Solar And Energy Storage Systems	3	0	0	3
2	MPS017	Industrial Power System Analysis And Design	3	0	0	3
3	MPS018	Research Methodology	3	0	0	3

SEMESTER I

MMA111	APPLIED MATHEMATICS				L	T	P	C
	Total Contact Hours: 60				3	1	0	4
	Prerequisite:UG Mathematics							
	Course Designed by : Dept. of Mathematics							
OBJECTIVES								
To apply all taught techniques to unseen problems, and present basic concepts of matrices and matrix algebra, linear transformation, vector spaces,Random variable compute and interpret measures of correlation/covariance ,calculus is major branch of optimization deals with extreme values in certain function spaces.								
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 and solve the fundamental problems with prescribed or free boundary conditions in simple cases.							
CO3	Learn to understand how signals, systems, inference combine in prototypical tasks of communication, control and signal processing.							
CO4	Apply concepts of Probability to solve problems in Electronic Engineering							
CO5	Find functional relationship between random inputs and outputs with the use of Random Process Techniques. Find the linearity in Birth and Death Processes with the use of Poisson 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		
2	CO1	H	H	L	M			
	CO2		H	L				
	CO3			H		M		
	CO4	M	H			L		
	CO5		H	H	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Eigen values using QR transformations generalized eigenvectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

UNIT II CALCULUS OF VARIATIONS

9+3 Variation and its properties – Euler’s Equation – Functional dependent on first and higher 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.

UNIT III SPECIAL FUNCTIONS

9+3

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

UNIT IV PROBABILITY

9+3

Probability concepts – Random variables Discrete and continuous dissimulations – Correlations – partial, multiple, rank analysis of variance one way, two way process.

UNIT V RANDOM PROCESS

9+3

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. Andrews 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.

MPS101	POWER SYSTEM ANALYSIS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Power system				

		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To understand the necessity of load flow studies and short circuit analysis						
COURSE OUTCOMES (COs)						
CO1	Able to develop mathematical models for analysis.					
CO2	Able to select proper methodologies of load flow studies for the power network.					
CO3	Able to develop the understanding of contingency Analysis.					
CO4	Able to develop programs for power system studies.					
CO5	Able to apply concepts of Stability 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				L
	CO2		H			
	CO3				H	M
	CO4			H		
	CO5		H		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

9

Balanced 3 phase networks-representation of power system components single line diagram-per unit systems – advantage of per unit system – impedance diagram of per unit system – primitive network.

UNIT II**LOAD FLOW****9**

Network Modeling – Formation of Y bus matrix-Gauss-seidal method-Newton Raphson method-Fast decoupled load flow-convergence criteria and tests-formulation of three phase load problem.

UNIT III**SOLUTION TECHNIQUES****9**

Sparse matrix techniques for large scale system-problems- Gauss elimination method-bifactorisation method.

UNIT IV**SHORT CIRCUIT STUDIES****9**

Analysis of three phase faults-admittance matrix equation-impedance matrix equation-fault calculations-analysis of unbalanced faults-admittance matrices-fault calculations-short circuit faults-open circuit faults-program description and typed solutions.

UNIT V**STABILITY STUDIES****9**

Transient stability analysis-swing equation stability of multi machine system-solution using modified Euler's method and Gauss-Seidal method

Total No. of Periods: 45**REFERENCE BOOKS:**

- 1.“Modern Power System Analysis” by Nagrath & Kothari – Tata McGraw Hill Publications 2003.
- 2.“Power System Analysis” by Hadi Saadat – Tat McGraw Hill Publications 2001.
- 3.Stagg G.Ward, El-Abiad: Computer methods in power system analysis, McGraw Hill ISE, 1986.

MPS102	POWR SYSTEM OPERATION AND CONTROL	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES To impart learning about the power system controls namely load-frequency AVR control for both single-machine infinite bus system and multimachine systems. and to learn optimal system operation through optimal generation dispatch, unit commitment, hydro-thermal scheduling and pumped storage plant scheduling and their implementation through various classical methods.						
COURSE OUTCOMES (COs)						
CO1	Understand Economic Dispatch Controller and solution of Coordinate equation by iterative method					
CO2	Understand & model reactive power -voltage interaction and different methods of control for maintaining voltage profile against varying system load					
CO3	Understand & model power -frequency dynamics and to design power -frequency controller.					
CO4	Understand Forecasting of base load and Unit commitment using different methods					
CO5	Understand generation and absorption of Reactive power and the methods of voltage control					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H				M
	CO2			H	H	
	CO3		H			L
	CO4		H			
	CO5			M		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

ECONOMIC LOAD DISPATCH

9

Economic dispatch problem-optimal operation of generators neglecting losses-generator scheduling including losses exact transmission loss formula-coordination equation-Automatic load dispatch

UNIT II

OPTIMAL SYSTEM CONTROL**9**

Optimal load flow solution-optimal scheduling of hydrothermal plant-optimal unit Commitment-Dynamic programming.

UNIT III**AUTOMATIC GENERATOR CONTROL****9**

Review of LFC and economic dispatch control using three modes of control flat frequency tie line control-tie line bias control-AGC implementation-AGC features static and dynamic response of controlled two area systems

UNIT IV**REACTIVE POWER CONTROL****9**

Reactive power control-voltage monitoring-application of voltage regulator-synchronous condenser-transformer taps-static Var compensators-thyristor switched capacitors-thyristor controlled reactors

UNIT V**POWER SYSTEM SECURITY****9**

Factors affecting system security-security levels-contingency analysis-linear sensitivity factors-dc power flow methods-contingency selection-concentric relaxation.

Total No. of Periods: 45**REFERENCE BOOKS:**

- 1.“Electric Energy System Theory” by I. Elgerd – Tata McGraw Hill publication 1999
- 2.“Power System Voltage Stability” by Taylor-McGraw Hill publications 2000
- 3.“Power System Analysis by Grainger Stevenson – McGraw hill publications 1989

MIC105	ADVANCED CONTROL THEORY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Control system				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
To study the analysis of systems using state space model						
To understand the concept of stability						
To familiarize the optimal control problem						
COURSE OUTCOMES (COs)						
CO1	Apply the knowledge of basic and advance control system for design of control systems.					
CO2	Understand and able to apply the concepts of state variable analysis for real time applications.					
CO3	To apply advanced control theory to practical engineering problems.					
CO4	To understand and apply nonlinear systems for real time applications.					
CO5	Analyze the concept of stability of nonlinear 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			
	CO3			M		H
	CO4		H			
	CO5	H			H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

7

PROPERTIES OF TRANSFER FUNCTION

Impulse response matrices- poles & zeros of transfer function matrices critical frequencies resonance-steady state and dynamic response bandwidth-singular value, Analysis-multivariable Nyquist plots.

UNIT II**8****REVIEW OF STATE MODEL FOR SYSTEMS**

State transition matrix & its properties-free and forced response control ability and observability-kalman's Decomposition-Minimal realization.

UNIT III**10****STATE FEEDBACK AND STATE ESTIMATORS**

Single variable case-connection of state feedback and state estimators Compensation design-design concepts-realization of basic compensation-cascade compensation in time domain and frequency domain .

UNIT IV**11****TYPES OF NON-LINEARITY**

Typical examples-phase plane analysis-isoclines method-limit cycles Equation Linearization-Describing function-Describing function analysis of simple non linear systems.

UNIT V**9****STABILITY CONCEPTS**

Equilibrium points-BIBO & Asymptotic stability-direct method of liapnov-variable gradient method of generating liapnov functions-applications to non-linear problems-krasakovskils theorem on global asymptotic stability of non linear systems.

Total No. of Periods: 45**Text Books:**

1. Gopal M. Modern control system theory, New age International pvt Ltd, 2002.

References:

1. Nagrath & Gopal, Control system engineering, Wiley & Sons, 1982.
- 2.Ogata K. 11, Modern control engineering, PHI, 1982.
- 3.Ogata K.H, State space analysis of control systems, PHI.
- 4.Tou.J.T. Modern control theory, McGraw hill.

SEMESTER II

MPS201	POWER SYSTEM DYNAMICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Basics of Electrical Machines				
		Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES						
To equip students with adequate knowledge of Introduction to steady state transient and dynamic stability of power systems						
COURSE OUTCOMES (COs)						
CO1	Study about the Steady State Transient and Dynamic Stability Of Power Systems, States of Operation and System Security and its Analysis.					
CO2	Know the Voltage And Torque Equations and Modeling Of Induction and synchronous machine.					
CO3	To learn and analyze the modeling of power system components .Analysis the Modeling of Prime Mover Control System and Modeling Of Turbines					
CO4	To understand analyze the power system stabilizers and dynamics of synchronous machine.					
CO5	Study the Sub Synchronous Resonance In Compensated Systems and voltage stability.					
Mapping of Course Outcomes with 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	M	L	M	L
	CO2	M	L	L	M	L
	CO3	M	M	L	M	L
	CO4	H	M	L	H	L
	CO5	H	M	L	H	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I 9

POWER SYSTEM STABILITY

Introduction to steady state transient and dynamic stability of power systems-states of operation and system security-analysis of steady state and transient stability-classical methods of solutions-numerical solution-point by point method, equal area criterion-effect of damper winding and governor.

UNIT II 9

SYNCHRONOUS AND INDUCTION MACHINE MODELLING

Synchronous machine modeling-flux linkage, voltage and torque equations-Park's transformation-transformation of flux linkage, voltage and torque equations-modeling of induction motors-representation in stability studies.

UNIT III 9

MODELLING OF POWER SYSTEM COMPONENTS

Excitation systems-Classification, modeling-prime mover control system-modeling of turbines, speed-governing systems-modeling of transmission line-Static Var compensators-load modeling.

UNIT IV 9

DYNAMICS OF SYNCHRONOUS MACHINES

Synchronous machine model-Application of Models-Small signal analysis-Synchronizing and Damping torque analysis-Power system stabilizers-Structure and tuning of power system stabilizers.

UNIT V 9

SUBSYNCHRONOUS RESONANCE AND VOLTAGE STABILITY

Sub synchronous resonance in compensated systems-Counter measures for SSR-Filtering and damping schemes-Voltage stability-Factors affecting voltage instability and collapse-Comparison of Angle and Voltage stability –Analysis and control of voltage instability.

Total No. of Periods: 45

Text Books:

1. P. Kundur, "Power System Stability and Control", McGraw-Hill, 1993.
2. IEEE Committee Report, "Dynamic Models for Steam and Hydro Turbines in Power System Studies", IEEE Trans., Vol.PAS-92, pp 1904-1915, November/December, 1973. on Turbine-Governor Model.

References

1. P.M Anderson and A.A Fouad, "Power System Control and Stability", Iowa State University Press, Ames, Iowa, 1978. MPS202

MPS202	POWER SYSTEM TRANSIENTS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Protection and Switchgear				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
Develop a basic understanding of the transient effect of lightning,faults, and switching on po systems. Provide a basic understanding of the principles used to protect power systemequipm from transients.						
COURSE OUTCOMES (COs)						
CO1		To understand the Source, Effects and Importance of Transients.				
CO2		To understand the Forms and Effects of Switching Transients				
CO3		To understand the transients in integrated power systems				
CO4		Understanding the lumped parameters & travelling waves on transmission lines				
CO5		Understanding the Phenomenon of lighting and Protection of Devices from Lighting				
Mapping of Course Outcomes with 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	
	CO2		H			H
	CO3	H				
	CO4		M	H	M	
	CO5	H	H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

5

INTRODUCTION AND SURVEY

Review of various types of power system transients-effect of transients on power systems-relevance of the study and computation of power system transients.

UNIT II

10

LIGHTNING SURGES

Electrification of thunder clouds-lightning current surges-lightning current parameters and their values-Stroke to tower and mid span-induced lightning surges.

UNIT III

10

SWITCHING SURGES

Closing and reclosing of lines-toad rejection-fault initiation-fault clearing-short line faults-Ferro-resonance-isolator switching surges-temporary over voltages-surges on an integrated system-switching-harmonics.

UNIT IV

COMPUTATION OF TRANSIENTS IN CONVERSION EQUIPMENT 10

Traveling wave method Transmission and Reflection of Waves at various junctions-Beweley's Lattice diagram-Eigen value approach-Z-transform –EMTP software.

UNIT V

PROTECTIVE DEVICES AND SYSTEMS

10

Basic ideas about protection-Surge diverters'-Surge absorbers-Ground fault neutralizers-Protection of lines and stations by shielding-Ground wires-Counter poises-Driven rods-Modern lightning arresters-Insulation coordination-protection of alternators-Industrial drive systems.

Total No. of Periods: 45

REFERENCE BOOKS:

- 1.Allen Greenwood, electrical transients in power systems, willey interscience, New York, 1971.
- 2.Klaus ragaller, Surges in high voltage networks, Plenum Press, New York, 1980.
- 3.Diesendorf, W. Over voltages on high voltage systems, reneelaer Bookstore, Troy New York.1971.

MPS203	HIGH VOLTAGE DC TRANSMISSION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Power Electronics, High Voltage Engineering.				
	Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES					
To mould the students to acquire knowledge about HVDC Transmission systems					

COURSE OUTCOMES (COs)						
CO1	To get an idea about modern trends in HVDC Transmission and its application					
CO2	To complete analysis of harmonics and basis of protection for HVDC Systems.					
CO3	To understand the power flow control on HVDC Transmission system					
CO4	To Understand the Operation of the controller for HVDC in worst and normal operations					
CO5	To understand the complete operation of HVDC Converter stations					
Mapping of Course Outcomes with 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
	CO2	H	H	H	M	M
	CO3	H	M	M	M	
	CO4	H	M		M	
	CO5		M		M	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Comparison of AC and DC transmission-Types of DC links-components of HVDC systems principal application of DC transmission-merits and demerit of DC transmission-modern trends in DC transmission

UNIT II THYRISTOR CONVERTORS AND ANALYSIS

9

Thyristors-switching and steady state characteristics-valve firing-recent trends-pulse number converter configuration-analysis of Gratez circuit-converter bridge characteristics pulse

converter.

UNIT III HVDC SYSTEM CONTROL 9

Desired features of control-converter control characteristics-constant current control extinction angle control-system control-firing angle control Reactive power control

UNIT IV STABILITY ANALYSIS 9

Modeling of converter-DC network and synchronous generator-solution methodology-transient stability improvement using DC link control voltage stability in AC-DC systems control.

UNIT V POWER MODULATION AND HARMONICS 9

Power modulation controls, reactive power modulation. Characteristic harmonics-troubles due to harmonics-harmonic filters.

Total Periods:45

REFERENCES:

1. HVDC Power transmission system-Padiyar K.R. wiley Eastern Pvt. Ltd. 1980.
2. Direct current Transmission-Kimbark, Vol 1., John Wiley, New York, 1971.
3. Computer Modeling of electric Power Systems-Arriliaga J. and Arnald C.P. & Parker B.J., John wiley& Sons, 1983.

MPS2L1	POWER SYSTEM SIMULATION LAB	L	T	P	C
	Total Contact Hours:45			4	2
	Prerequisite: Power System Analysis				

		Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES						
To equip students with adequate knowledge of Short Circuit Analysis Using Matlab Program, Transient Stability Analysis of Single Machine To Infinite Bus System						
COURSE OUTCOMES (COs)						
CO1	Study the Short Circuit Analysis Using Matlab Program.					
CO2	Know about the Load Frequency Dynamics of Single Area Bus System.					
CO3	Study of Monopolar operation using HVDC transmission line analyzer.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H		H		M
	CO2		H	H		
	CO3	H		H	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS:

1. Short Circuit Analysis Using Matlab Program
2. Transient Stability Analysis of Single Machine To Infinite Bus System
3. A Solution to Economic Dispatch in Power System

4. Swing Curve
5. Load Frequency Dynamics of Single Area Bus System
6. Load Frequency Dynamics of Two Area Bus System
7. Analysis of Transmission Line Parameters
8. Study of Monopolar operation using HVDC transmission line analyzer.
9. Study of Bipolar operation using HVDC transmission line analyzer.
10. Study of Earth fault relay using HVDC transmission line analyzer.
11. Study of EMTP Software

REFERENCES

1. Department Lab Manual

SEMESTER III

MPS301	POWER SYSTEM PROTECTION	L	T	P	C
	Total Contact Hours:60	3	1	0	4
	Prerequisite:Basics of power system protection				

		Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES						
• To educate the causes of abnormal operating conditions (faults, lightning and switching surges) the apparatus and system.						
• To introduce the characteristics and functions of relays and protection schemes						
• To impart knowledge on functioning of circuit breakers						
COURSE OUTCOMES (COs)						
CO1		Ability to understand and analyze power system Equipment protection and their operation				
CO2		Ability to apply the over current protection scheme in the power systems				
CO3		Able to apply the distance and carrierProtection for Transmission Lines				
CO4		Ability to understand and apply bus bar protection schemes in power systems				
CO5		Able to apply thenumerical relay and protection schemes				
Mapping of Course Outcomes with 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	M	M			
	CO2	M	M	M		M
	CO3	M	H		M	M
	CO4	M	M		M	
	CO5	H	H		M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I EQUIPMENT PROTECTION

12

Types of transformers – Phasor diagram for a three – Phase transformer-Equivalent circuit of transformer – Types of faults in transformers- Over – current protection – Percentage Differential Protection of Transformers - Inrush phenomenon-High resistance Ground Faults in Transformers - Inter-turn faults in transformers – Incipient faults in transformers - Phenomenon of over-fluxing in transformers – Transformer protection application chart. Electrical circuit of the generator – Various faults and abnormal operating conditions-rotor fault – Abnormal operating conditions.

UNIT II OVER CURRENT PROTECTION 12

Time – Current characteristics-Current setting – Time setting-Over current protective schemes - Reverse power or directional relay - Protection of parallel feeders - Protection of ring feeders - Earth fault and phase fault protection - Combined Earth fault and phase fault protection scheme - Phase fault protective scheme directional earth fault relay - Static over current relays.

UNIT III DISTANCE AND CARRIER CURRENT PROTECTION FOR TRANSMISSION LINES 12

Drawback of over – Current protection – Introduction to distance relay – Simple impedance relay – Reactance relay – mho relays comparison of distance relay – Distance protection of a three – Phase line- reasons for inaccuracy of distance relay reach - Three stepped distance protection - Trip contact configuration for the three - Stepped distance protection - Impedance seen from relay side - Three-stepped protection of double end fed lines-need for carrier – Aided protection – Various options for a carrier –Coupling and trapping the carrier into the desired line section - Unit type carrier aided directional comparison relaying – Carrier aided distance schemes for acceleration of zone II.

UNIT IV BUS BAR PROTECTION 12

Introduction – Differential protection of busbars-external and internal fault – Actual behaviors of a protective CT - Circuit model of a saturated CT - External fault with one CT saturation; Need for high impedance – Minimum internal fault that can be detected by the high – Stability ratio of high impedance busbar differential scheme - Supervisory relay-protection of three – Phase busbars.

UNIT V NUMERICAL PROTECTION 12

Introduction – Block diagram of numerical relay - Sampling theorem- Correlation with a reference wave – Least error squared (LES) technique - Digital filtering-numerical over - Current protection – Numerical transformer differential protection-Numerical distance protection of transmission line.

Total No of periods: 60

REFERENCES

1. Paithankar.Y.G and Bhide.S.R, “Fundamentals of Power System Protection”, Prentice-Hall of India, 2003
2. Badri Ram and Vishwakarma.D.N, “Power System Protection and Switchgear”, Tata McGraw- Hill Publishing Company, 2002.
3. Kundur.P, “Power System Stability and Control”, McGraw-Hill, 1993

**ELECTIVES
PROGRAMME ELECTIVE (CE) – I**

MPS001	SPECIAL ELECTRICAL MACHINES AND CONTROLLERS	L	T	P	C
	Total Contact Hours:45	3	0	0	3

		Prerequisite: Basics of Electrical machines				
		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To expose the students to the concepts of various types of special electrical machines and their applications						
COURSE OUTCOMES (COs)						
CO1	Understand axial and radial air gap of Synchronous Reluctance Motors					
CO2	Describe open loop control, closed loop control of stepping motor.					
CO3	Analyze microprocessor based controller of Switched Reluctance Motor					
CO4	Able to derive the EMF equation, Torque – Speed characteristics Controllers Of Permanent magnet brushless dc motors					
CO5	Able to derive EMF equation, Torque – Speed characteristics Controllers of Permanent Magnet Synchronous Motors					
Mapping of Course Outcomes with 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		M		M
	CO2		H		H	
	CO3			H		
	CO4	H	H		M	H
	CO5	H	H	M		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

SYNCHRONOUS RELUCTANCE MOTORS

9

Constructional features-types-axial and radial air gap motors-operating principle-reluctant torque-phasor diagram-characteristics-Vernier motor.

UNIT II

STEPPING MOTORS

9

Constructional features-principle of operation-variable reluctance motor Hybrid motor-single and multi stack configurations-theory of torque predictions-linear and non linear analysis-characteristics-drive circuits.

UNIT III

SWITCHED RELUCTANCE MOTORS

9

Constructional features-principles of operation-torque prediction-power controllers-nonlinear analysis-Microprocessor based control characteristics-computer control.

UNIT IV

PERMANENT MAGNET BRUSHLESS D.C. MOTORS

9

Principle of operation-Types-Magnetic circuit analysis-EMF and torque equations-Power controllers-Motor characteristics and control.

UNIT V

PERMANENT MAGNET SYNCHRONOUS MOTORS

9

Principle of operation-EMF and torque equations-reactance –phasor diagram-Power controllers-Converter volt-ampere requirements-Torque speed characteristics-Microprocessor based control.

Total No. of Periods: 45

References:

1. A Nazar and I Boldea, Linear Electric Motors, Theory, Design and Practical applications, Prentice Hall Inc, New/Jersey, 1987.
2. Brushless permanent Magnet and Reluctance Motor Drives-Miller T.J.E. clarendon Press, Oxford. 1989.
3. Permanent Magnet and Brushless DC Motors, Kenjo T. and Naganori S. clarendon Press, Oxford 1989.
4. Stepping Motors and their Microprocessor Control-Kenjo t. clarendon Press Oxford 1989.

MPS002	ELECTRICAL DISTRIBUTION SYSTEM	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Transmission and Distribution				
	Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES					

To master the complete idea of Electrical Distribution by learning planning strategies, reliability analysis, distribution protection and the voltage control in distribution systems.						
COURSE OUTCOMES (COs)						
CO1		To learn the structure and operation of Electrical Distribution systems.				
CO2		To learn the planning strategies of Electrical Distribution systems.				
CO3		To have a clear understanding of reliability analysis.				
CO4		To learn the voltage control and its advancements in distribution.				
CO5		To learn the protection of feeders, distributors and service mains.				
Mapping of Course Outcomes with 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				M
	CO2		H		H	
	CO3			M		H
	CO4	H				
	CO5		H	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I

INTRODUCTION

9

Industrial and commercial distribution systems-Energy losses in distribution system –system ground bonding for safety and protection comparison of O/H lines and underground cable system-single phase and three phase unbalanced network model-power flow, short circuit and loss calculations.

UNIT –II**RELIABILITY ANALYSIS**

9

Distribution system reliability analysis-reliability concepts –Markov model-distribution network reliability-reliability performance

UNIT-III**DISTRIBUTION SYSTEM PLANNING**

9

Distribution system expansion planning-load characteristic-load forecasting-design concepts – optimal location of substation-design of radial lines-solution technique

UNIT-IV**VOLTAGE CONTROL OF DISTRIBUTION SYSTEM**

9

Voltage control-Applications of shunt capacitance for loss reduction-Harmonics in the system-static VAR systems-optimization for loss reduction and voltage improvement.

UNIT-V**DISTRIBUTION SYSTEM PROTECTION**

9

System protection – requirement – fuses and section analyzers over current. Under voltage and under frequency protection- coordination of protective device.

Total no of periods: 45**References:**

Electrical Power systems Planning – Pabka,
Power System Voltage Stability – Taylor,

MPS003	POWER SYSTEM STABILITY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Power System Transients				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
To give basic knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modeling issues.						
COURSE OUTCOMES (COs)						
CO1	To gain a deep understanding on power system modeling for stability analysis.					
CO2	To gain a deep understanding of power system behavior under transient condition.					
CO3	Analyze the performance of single and multi-machine systems under transient, steady state and dynamic conditions.					
CO4	Analyze the factors effect voltage stability and analysis of factors and solutions of control of voltage instability					
CO5	Analyze the various Methods of improving stability					
Mapping of Course Outcomes with 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			
	CO3			H		
	CO4		M		H	
	CO5	M		M		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

POWER SYSTEM STABILITY CONSIDERATIONS

9

Introduction-Stability classifications -rotor angle and voltage stability-synchronous machine representation –classical model-load modeling concepts-modeling of excitation systems-modeling of prime movers.

UNIT II**TRANSIENT STABILITY****9**

Swing equation-equal area criterion-solution of swing equation-Numerical methods -Euler method-Runge-Kutta method-critical clearing time and angle-effect of excitation system and governors-Multi machine stability –extended equal area criterion-transient energy function approach.

UNIT III**SMALL SIGNAL STABILITY****9**

State space representation – eigen values- modal matrices-small signal stability of single machine infinite bus system – synchronous machine classical model representation-effect of field circuit dynamics-effect of excitation system-small signal stability of multimachine system.

UNIT IV**VOLTAGE STABILITY****9**

Generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads – load ability limit - sensitivity analysis-continuation power flow analysis - instability mechanisms-examples.

UNIT V**STABILITY IMPROVEMENT****9**

Methods of improving stability – transient stability enhancement – high speed fault clearing – steam turbine fast valving-high speed excitation systems- small signal stability enhancement-power system stabilizers – voltage stability enhancement – reactive power control.

Total No. of Periods: 45**REFERENCE BOOKS:**

- 1.Kundur, P., “Power System Stability and Control”, McGraw-Hill International Editions, 1994.
- 2.Anderson, P.M. and Fouad, A.A., „Power System Control and Stability“, Galgotia Publications, New Delhi, 2003.

PROFESSIONAL ELECTIVE (CE) – II

	POWER QUALITY	L	T	P	C
	Total Contact Hours:45	3	0	0	3

MPS004		Prerequisite:				
		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
Understand the various power quality phenomena their origin and monitoring and mitigation methods. Understand the effects of various power quality phenomenon on various equipment.						
COURSE OUTCOMES (COs)						
CO1	Able to know the severity of power quality problems in distribution system					
CO2	Able to understand the analysis of single phase and three phase system					
CO3	Able to Conventional load compensation methods					
CO4	Able to understand the concepts of load compensation.					
CO5	Understanding the basics 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	a	b	c	d	e
2	CO1			M	H	
	CO2	H				
	CO3					H
	CO4	H			H	
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

9

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, Non linear 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

Single phase linear and non linear 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 non linear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III

CONVENTIONAL LOAD COMPENSATION METHODS

9

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

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

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

Total No of periods: 45

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. Arrillaga
5. Power Electronic Converter Harmonics –Derek A. Paice.

MPS005	POWER SYSTEM PLANNING AND RELIABILITY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Transmission and Distribution				

		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To learn the basic concepts of reliability models, approaches and distribution system planning.						
COURSE OUTCOMES (COs)						
CO1	Study about the Load growth patterns and their importance in planning.					
CO2	Learn about the Probabilistic generation and load models.					
CO3	Study the concepts of Fuzzy load flow probabilistic transmission system reliability analysis.					
CO4	Study the procedure followed for integrate transmission system planning.					
CO5	Learn the Distribution System Protection And Coordination of Protective 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
2	CO1	H		M		H
	CO2		H		M	H
	CO3	H		H		
	CO4				H	
	CO5		H		H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

LOAD FORECASTING

9

Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting Based on discounted multiple regression technique-Weather sensitive load

forecasting-Determination of annual forecasting-Use of AI in load forecasting.

UNIT II

GENERATION SYSTEM RELIABILITY ANALYSIS

9

Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of ISO and interconnected generation systems.

UNIT III

TRANSMISSION SYSTEM RELIABILITY ANALYSIS

9

Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.

UNIT IV

EXPANSION PLANNING

9

Basic concepts on expansion planning-procedure followed for integrate transmission system planning, current practice in India-Capacitor placer problem in transmission system and radial distributions system.

UNIT V

DISTRIBUTION SYSTEM PLANNING OVERVIEW

9

Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices.

Total No of periods: 45

References:

1. Proceeding of work shop on energy systems planning & manufacturing CI.
2. R.L .Sullivan, “Power System Planning”,
3. Roy Billinton and Allan Ronald, “Power System Reliability.”
4. Turan Gonen, Electric power distribution system Engineering ‘McGraw

MPS006	RESTRUCTURED POWER SYSTEM	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Power System				

		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To study the complete process of deregulation and restructuring of Power Industry						
COURSE OUTCOMES (COs)						
CO1		To learn the issues involving in restructuring and deregulation of Power Network.				
CO2		To learn the various fundamentals of Electricity market and its functions.				
CO3		To have a clear understanding Congestion management.				
CO4		To learn the various fundamentals of Marginal Pricing and Transmission Rights.				
CO5		To learn the pricing in different market strategies.				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H			H	
	CO2	H	H	M		H
	CO3			M		
	CO4		M			H
	CO5	M			H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY

9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of

various market models

UNIT II

TRANSMISSION CONGESTION MANAGEMENT

9

Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III

LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS

9

Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation — Flow gate rights – FTR and market power

UNIT IV

ANCILLARY SERVICE MANAGEMENT

9

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service

UNIT V

PRICING OF TRANSMISSION NETWORK

9

Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.

Total No. of Periods: 45

References:

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, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001
4. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boelen,” Operation of restructured power systems”, Kluwer Academic Pub., 2001.

PROFESSIONAL ELECTIVE (CE) – III

MPS007	HIGH VOLTAGE ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				

		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To understand the various types of over voltages in power system , Generation of over voltages protection methods and Measurement of over voltages in laboratories						
COURSE OUTCOMES (COs)						
CO1	Identify various causes of over voltages, currents and their effects on power system.					
CO2	To understand electrical breakdown in gases, solids and liquids					
CO3	To understand the generation of high voltages and high currents in power system					
CO4	Measurement of over voltages and Generation of over voltages in laboratories.					
CO5	To understand the various types of testing of high voltages 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	a	b	c	d	e
2	CO1	H		M		H
	CO2			M		
	CO3	H	H		H	
	CO4		H		M	H
	CO5		H	M		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

OVER VOLTAGES AND INSULATION COORDINATION

9

Natural causes of over voltages-lightning phenomena-over voltages due to switching surges-system faults and other abnormal conditions-principles of insulation coordination.

UNIT II**ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS 9**

Classical gas laws-ionization and decay processes-secondary effects –paschen’s law – streamer theory-breakdown in non uniform fields and corona discharges-practical considerations in using gages for insulation purposes-vacuum insulation conduction and breakdown in pure and commercial liquids. Intrinsic break down in solids-electromechanical breakdown –thermal breakdown in composite dielectrics.

UNIT III**GENERATION OF HIGH VOLTAGE AND HIGH CURRENTS 9**

Generation of high dc voltage, alternating voltage, impulse voltage and impulse current.

UNIT-IV**MEASUREMENTS OF HIGH VOLTAGE AND HIGH CURRENTS 9**

Measurement of high voltage and high currents- digital technique in high voltage measurements.

UNIT V**HIGH VOLTAGE TESTING 9**

High voltage testing of electrical apparatus power frequency, impulse voltage and dc ,international and Indian standards

Total no of periods: 45

References:

1. M.S.Naidu and V.kamaraju High voltage engineering Tata Mc Graw Hill 2nd edition 1995.
2. Kuffel E and Zaengi. W.S. High voltage engineering fundamentals pergamon press Oxford London 1986

MPS008	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:Electrical Machines,Power System.				

		Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES						
To equip the students with Demand meters and energy management and auditing concepts.						
COURSE OUTCOMES (COs)						
CO1		Study the Designing And Starting An Energy Management Program.				
CO2		Understand an Economic models, Time value of money, Utility rate structures and load management.				
CO3		Study the Electric motors-Transformers and reactors-Capacitors				
CO4		Know about the Demand meters - Paralleling of current transformers and metering techniques.				
CO5		To understand the lighting concepts and the effects of harmonics on power quality.				
Mapping of Course Outcomes with 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	M	M	L	M
	CO2	L	L	L	L	M
	CO3	M	M	L	L	L
	CO4	M	L	L	L	L
	CO5	L	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

9

Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process.

UNIT II

ENERGY COST AND LOAD MANAGEMENT

9

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification

UNIT III

ENERGY MANAGEMENT FOR MOTORS & ELECTRICAL EQUIPMENT

9

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines

UNIT IV

METERING FOR ENERGY MANAGEMENT

9

Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples

UNIT V

LIGHTING SYSTEMS

9

Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards

Total No of Periods : 45

Text Books :

1. Reay D.A, Industrial Energy Conservation, first edition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.

References :

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

MPS009	COMPUTER METHODS FOR POWER SYSTEM ANALYSIS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Power System Analysis				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
• To provide the students in getting basic idea of different computer methods in power systems and to analyze the various methods of Power Flow studies, short circuit analysis and Stability analysis						
COURSE OUTCOMES (COs)						
CO1	Ability to understand the concepts of Network modeling Conditioning of Y Matrix					
CO2	Ability to develop the Sequential Solution Techniques for DC system model					
CO3	Ability to conduct short circuit analysis					
CO4	Ability to conduct analysis of power system for steady state stability and Transient stability					
CO5	Ability to form the contingency constrained optimal 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	a	b	c	d	e
2	CO1	H			H	M
	CO2			H		
	CO3		H			H
	CO4		H		H	
	CO5	H		H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I

LOAD FLOW

9

Network modeling-Conditioning of Y Matrix-Newton Raphson method-Decoupled Newton Load flow-Convergence criteria and tests –formulation of three phase load flow problem.

UNIT II

AC-DC LOAD FLOW**9**

Formulation of the problem-DC system model-Sequential Solution Techniques –Extension to Multiple and Multi terminal DC systems-DC convergence tolerance-Test systems and Results.

UNIT III**FAULT STUDIES****9**

Analysis of three phase faults-Admittance matrix equation-impedance matrix equation-fault calculations-Analysis of unbalanced Faults –Admittance matrices-fault calculations –short circuit faults –open circuit faults-Program description and typed solutions.

UNIT IV**STABILITY STUDIES****9**

Transient stability analysis: Swing equation – stability of multi-machine systems –Solution using modified Euler method and gauss-seidal method.

UNIT V**SYSTEM OPTIMISATION****9**

Objectives – strategy for two generator system – generalized strategies – effect of transmission losses-Sensitivity of objective function-formulation of contingency constrained optimal power flow problem.

Total No. of periods: 45**REFERENCE BOOKS:**

- 1.Computer Aided power systems Analysis –M.A. Pai
- 2.Modem power system analysis-Nagrath & Kothari Tata Mc Graw hill Ltd.,

PROFESSIONAL ELECTIVE (CE) – IV

MPS010	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Electrical Machines, Power system				

		Course Designed by : Dept of Electrical & Electronics Engineering				
OBJECTIVES To understand and analyze the present and future energy demand of world and nation. Techniques to exploit the available renewable energy resources such as, wind power effectively.						
COURSE OUTCOMES (COs)						
CO1		To understand and analyse the basic schemes and components of wind energy conversion system.				
CO2		To understand and analyse the design concepts of wind turbines				
CO3		To understand the concepts of fixed speed wind energy conversion systems				
CO4		To understand the concepts of variable speed, wind energy conversion systems				
CO5		To analyze the grid integration 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
2	CO1	M	M	L	M	L
	CO2	H	M	L	H	L
	CO3	M	M	L	M	L
	CO4	M	H	L	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION TO WECS 9

Components of WECS-Schemes of WECS-Power obtained from wind- simple momentum theory- power coefficient- Sabinin's theory- Aerodynamic s of wind turbine.

UNIT-II

WIND TURBINES 9

HAWT-VAWT-Power developed –Thrust – Efficiency- Rotor selection – Rotor design considerations- Tip Speed ratio- No of Blades- Blade profile-Power Regulation-Yaw control- Pitch angle control-stall control- Schemes for maximum power extraction.

UNIT-III 9

FIXED SPEED SYSTEMS

Generating Systems- Constant speed constant frequency systems- Choice of Generators- Deciding factors- synchronous Generator- squirrel cage induction Generator- Model Wind turbine rotor-Drive Train Model- Generator model for steady state and Transient Stability analysis.

UNIT-IV 9

VARIABLE SPEED SYSTEMS

Need of variable speed systems- Power-Wind speed Characteristics –Variable speed constant frequency systems synchronous generator- DFIG-PMSG-Variable speed generators modeling- Variable speed variable frequency schemes.

UNIT-V 9

GRID CONNECTED SYSTEMS

Stand alone and Grid connected WECS system – Grid connection Issues- Machine side & Grid Side controllers- WECS in various countries.

Total Periods: 45

TEXT BOOKS:

1. L.L.Freris “Wind Energy Conversion Systems”, Prentice Hall,1990.
2. Ion Boldea, ”Variable Speed Generators”, Taylor & Francis group,2006.

REFERENCE

1. E.W.Golding “The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
2. S.Heir “Grid Integration of WECS”, Wiley 1998.
3. L.L.Freris “Wind Energy Conversion Systems”, Prentice Hall,1990.
4. Ion Boldea, ”Variable Speed Generators”, Taylor & Francis group,2006.
5. E.W.Golding “The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
5. S.Heir “Grid Integration of WECS”, Wiley 1998.

MPS011	FACTS Controllers	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Power System and Power Electronics				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
To acquire the knowledge on flexible AC Transmission System and its importance for FACTS controllers. To understand the various FACTS controllers operation on FACTS systems.						
COURSE OUTCOMES (COs)						
CO1	Analyse uncompensated and compensated AC transmission lines.					
CO2	Describe the principle of operation and configuration of SVC .					
CO3	Describe the structure, functions and applications of TCSC and GCSC.					
CO4	Describe the structure, functions and applications of STATCOM, SSSC, UPFC and IPFC.					
CO5	Describe the operation of coordination of controllers					
Mapping of Course Outcomes with 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
	CO2		H	M	H	
	CO3	H	H		H	M
	CO4		H			M
	CO5	H		M	H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

9

Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers.

UNIT II

STATIC VAR COMPENSATOR (SVC)

9

Configuration of SVC- voltage regulation by SVC- Modeling of SVC for load flow analysis- Modelling of SVC for stability studies-Design of SVC to regulate the mid-point voltage of a SMIB system- Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line.

UNIT III

THYRISTOR & GTO THYRISTOR CONTROLLED SERIES CAPACITORS (TCSC and GCSC)

9

Concepts of Controlled Series Compensation – Operation of TCSC and GCSC- Analysis of TCSC-GCSC – Modeling of TCSC and GCSC for load flow studies- modeling TCSC and GCSC for stability studied- Applications of TCSC and GCSC.

UNIT IV

VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS

9

Static synchronous compensator(STATCOM)- Static synchronous series compensator(SSSC)- Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC- Modeling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers(UPFC and IPFC)- Modeling of UPFC and IPFC for load flow and transient stability studies- Applications.

UNIT V

CONTROLLERS AND THEIR COORDINATION

9

FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

Total No of Periods: 45

References:

1. A.T.John, “Flexible AC Transmission System”, IEEE,1999.
2. Narain G.Hingorani, Laszio. Gyugyl, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, Standard Publishers, Delhi 2001.
3. V. K.Sood, “HVDC and FACTS controllers- Applications of Static Converters in Power System”, 2004, Kluwer Academic Publishers.
4. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc.
5. K.R.Padiyar,” FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd., Publishers New Delhi, Reprint 2008,

MPS012	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Power Generation Systems				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES						
To grasp basic principles and applications of different distributed generation systems and to study concept of Micro-grid and its configuration						
COURSE OUTCOMES (COs)						
CO1	Understand the Conventional power generation systems					
CO2	Understand that distributed generation systems in microgrids can offer increased reliability and reduced network losses.					
CO3	Describe the Impact of grid integration					
CO4	Describe the concept of Microgrid and its configuration					
CO5	Apply advanced analysis tools in planning and operation of smart grids					
Mapping of Course Outcomes with 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		M		
	CO2		H		H	H
	CO3		H		H	
	CO4	H		M		
	CO5	H		H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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**

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 microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

UNIT V**CONTROL AND OPERATION OF MICROGRID**

9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Total No of Periods: 45

Text books:

1. “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, Amirnaser Yazdani, and Reza Iravani, IEEE John Wiley Publications.
2. “Power Switching Converters: Medium and High Power”, Dorin Neacsu, CRC Press, Taylor & Francis, 2006.
3. “Solar Photo Voltaics”, Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi, 2009
4. “Wind Energy Explained, theory design and applications,” J.F. Manwell, J.G. McGowan Wiley publication
5. “Biomass Regenerable Energy”, D. D. Hall and R. P. Grover, John Wiley, New York, 1987.

PROFESSIONAL ELECTIVE (CE) – V

	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3

MPS013		Prerequisite: Basics of Power System				
		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To master the concept of Artificial Intelligence and their usage in various Power System applications						
COURSE OUTCOMES (COs)						
CO1		To learn the basic concepts of expert systems and their applications				
CO2		To learn the concepts of artificial intelligence systems and their applications				
CO3		To master the programming in Artificial Neural Networks				
CO4		To use and analyze Artificial intelligence concepts for Power System problems				
CO5		To program, trouble shoot the neural network based 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
2	CO1	H		M		H
	CO2		H			
	CO3	M		H		M
	CO4				H	
	CO5		H	H		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

Basics of All systems-introduction to expert systems-definitions-architecture- differences-conventional programming.

UNIT II**EXPERT SYSTEMS****9**

Knowledge components-levels of representation-representation schemes-formal and non-formal representation schemes-ES building task-development-knowledge acquisition-typical building process.

UNIT III**INTRODUCTION TO NEURAL NETWORKS****9**

Neurobiological model of neurons-basics of ANN-perception-back propagation network-memory models-bi-directional associative memory-hop field network.

UNIT IV**ARTIFICIAL NEURAL NETWORKS****9**

Theory, architecture and applications of computer propagation network-Boltzmann's network-adaptive resonance theory-introduction to cognitron and neo-cognitron.

UNIT V**APPLICATIONS****9**

Application of expert systems and neural networks to load forecasting, contingency analysis-VAR control and other power system problems.

Total No. of Periods: 45**Reference:**

1. Rolston D.W. "Principles of Artificial Intelligence and Expert systems development", McGraw Hill, 1988.
2. Wasserman P.O. "Neural Computing", Van Reinhold, 1988.
3. Rich, Elaine, Kevin Knight, "Artificial Intelligence"

MPS014	NEURAL NETWORKS AND FUZZY LOGIC CONTROL	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Digital Electronics, Basics of set theory				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES To expose the students to the concepts of fuzzy sets and operations. To provide adequate knowledge about feed forward and back propagation neural networks. To have sound knowledge about neuron models,learning algorithms and applications.						
COURSE OUTCOMES (COs)						
CO1	To understand and analyze the fuzzy sets and fuzzy logic.					
CO2	To understand the fuzzy notations,fuzzy controllers and algorithms					
CO3	To understand and analyze artificial neural network architecture and algorithms					
CO4	To study about self organizing maps ,adaptive resonance theory and network architecture					
CO5	To apply the fuzzy and neural network concepts in real time applications image processing control system and signal processing.					
Mapping of Course Outcomes with 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	L	L	M	M	L
	CO2	M	M	M	M	L
	CO3	M	M	M	M	L
	CO4	M	M	L	M	L
	CO5	H	H	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

9

FUZZY SETS AND FUZZY SYSTEMS

Fuzzy sets – properties of fuzzy sets – representation of fuzzy sets – operations of fuzzy sets – fuzzy relation – relation composition. Fuzzy system– Rule based fuzzy system – linguistic model – Singleton model - Relational model – Takagi – Sugeno model – Dynamic fuzzy systems.

UNIT – II

9

FUZZY CLUSTERING AND FUZZY CONTROL

Basic notations – hard and fuzzy partitions – fuzzy C- means clustering – Gustafson – Kessel algorithm. Knowledge based fuzzy control – Motivation for fuzzy control – fuzzy control as a parameterization of controllers non-linearities – mamadani controller – Takasi - sugeno controller – fuzzy supervisory control.

UNIT – III

9

ARTIFICIAL NEURAL NETWORKS

Biological neuron – artificial neuron – neuron network architecture – learning – Multilayer neural network – radial based function network. Perception – multilayer perception architecture-Back propagation algorithm and its variant.

UNIT – IV

9

NETWORK ARCHITECTURES

Hopfield network-kohonen-Self organizing maps – ART I and II, Grossberg nets recurrent network – reinforcement learning.

UNIT – V

9

CONTROL BASED ON FUZZY AND NEURAL MODELS

Applications of fuzzy logic and neural network to measurement, control, signal processing and image processing.

Total No of Periods: 45

TEXT BOOKS:

1. Laurance Fausett, "Fundamentals of Neural Network", Prentice Hall, Englewood Cliffs N-S, 1992.
2. Jacek M. Zurava, Introduction to Artificial neural system, Jiaco publishing House, Mumbai. 1997.

REFERENCE:

1. Draiankor D. Hellendron H. Reinfrank. M. An introduction to fuzzy control Narosa publishing House. New Delhi 1996.
2. Timothy J- Ross. Fuzzy logic with engineering applications. International editions.

MPE015	SMART GRID	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: FACTS, Power Generation Systems, Transmission and Distribution				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES						
• To provide students with a working knowledge of fundamentals, design, analysis, and development of Smart Grid, from the basic concepts of power systems to the inherent elements of computational intelligence, communication technology and decision support system.						
COURSE OUTCOMES (COs)						
CO1	able toUnderstand the fundamental element of the smart grid,					
CO2	able toUnderstand the fundamental structure of the power grid					
CO3	use simulation tools such as Matlab and Paladin, for power flow analysis, optimization and state estimation					
CO4	understand communication, networking, and sensing technologies involved with the smart grid					
CO5	Develop computational techniques involved with the smart grid (decision support tools 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	a	b	c	d	e
2	CO1	M				
	CO2	H	H	H	H	M
	CO3	M	M		M	H
	CO4	M	M	H	M	M
	CO5	H	H	M	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION TO SMART GRID

9

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

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).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

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

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 FOR SMART GRID APPLICATIONS 9

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.

Total Periods: 45 Periods

REFERENCES:

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and
3. Improved Power Grid: A Survey", IEEE Transaction on Smart Grids,
4. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.
5. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,
6. "Smart Grid: Technology and Applications", Wiley.

OPEN ELECTIVE (OE) – I

MPS016	SOLAR AND ENERGY STORAGE SYSTEMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Renewable Energy Sources				

		Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES						
To Study about solar modules and PV system design and their applications , grid connected systems and about different energy storage systems						
COURSE OUTCOMES (COs)						
CO1		To understand the Characteristics of sunlight and solar cells				
CO2		To describe the stand alone PV system				
CO3		To understand Grid connected PV systems				
CO4		To know Energy storage systems				
CO5		To describe the Applications of solar 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			M	H
	CO2		H			
	CO3	H		M		H
	CO4		H		H	
	CO5	H		M		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION

9

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection.

UNIT II	9
STAND ALONE PV SYSTEM	
Solar modules – storage systems – power conditioning and regulation - protection – stand alone PV systems design – sizing.	
UNIT III	9
GRID CONNECTED PV SYSTEMS	
PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.	
UNIT IV	9
ENERGY STORAGE SYSTEMS	
Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage	
UNIT V	9
APPLICATIONS	
Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.	

Total No of Periods : 45

References:

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progenesa,1994.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.
3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
4. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

MPS017	INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Electrical & Electronics Engineering				
OBJECTIVES					

To analyze the motor starting and power factor correction and to perform computer-aided harmonic and flicker analysis and to design filters.						
COURSE OUTCOMES (COs)						
CO1		Understand the concept of motor starting methods				
CO2		Analyze the power factor correction studies				
CO3		Describe the System Model for Computer-Aided Analysis				
CO4		Understand the Flicker analysis				
CO5		Understand the Ground grid 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		M		
	CO2		H		H	
	CO3	H		H		M
	CO4				H	
	CO5	H	M	M		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

MOTOR STARTING STUDIES

9

Introduction-Evaluation Criteria-Starting Methods-System Data-Voltage Drop Calculations-Calculation of Acceleration time-Motor Starting with Limited-Capacity Generators-Computer-Aided Analysis-Conclusions.

UNIT II

POWER FACTOR CORRECTION STUDIES

9

Introduction-System Description and Modeling-Acceptance Criteria-Frequency Scan Analysis-Voltage Magnification Analysis-Sustained Overvoltages-Switching Surge Analysis-Back-to-Back Switching-Summary and Conclusions.

UNIT III

HARMONIC ANALYSIS

9

Harmonic Sources-System Response to Harmonics-System Model for Computer-Aided Analysis-Acceptance Criteria-Harmonic Filters-Harmonic Evaluation-Case Study-Summary and Conclusions.

UNIT IV

FLICKER ANALYSIS

9

Sources of Flicker-Flicker Analysis-Flicker Criteria-Data for Flicker analysis- Case Study-Arc Furnace Load-Minimizing the Flicker Effects-Summary.

UNIT V

GROUND GRID ANALYSIS

9

Introduction-Acceptance Criteria-Ground Grid Calculations-Computer-Aided Analysis - Improving the Performance of the Grounding Grids-Conclusions.

Total No of Periods: 45

REFERENCES

1. Ramasamy Natarajan, "Computer-Aided Power System Analysis", Marcel Dekker Inc., 2002.

MPS018	RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES						
COURSE OUTCOMES (COs)						
CO1						
CO2						
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					
	CO2					
	CO3					
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of

Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT II

MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT III

EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT IV

ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT V

REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

Total No of Periods: 45

TEXT BOOKS

1. Willktsion K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments“, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, „Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovsky, „Optimization of Engineering Experiments“, Meer Publication
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH- AUTOMOBILE ENGINEERING
PART TIME
I TO VI SEMESTERS

SEMESTER I							
SL. NO	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PM	MMA102	Advanced Mathematics for Automobile Engineers	3	2	0	4
2	PC	MAM 101	Thermal Engineering	3	2	0	4
3	PC	MAM 102	Automotive Engines and Subsystems	4	0	0	4
PRACTICAL							
4	PC	MAM 1L1	Automotive Engines Lab	0	0	2	2
			TOTAL	9	4	2	14

SEMESTER II							
SL. NO	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
1	PC	MAM 201	Automotive Electrical and Electronics	3	0	0	3
2	PC	MAM 202	Vehicle Body Engineering	3	0	0	3
3	PC	MAM 203	Vehicle Dynamics	3	2	0	4
PRACTICAL							
4	PC	MAM 2L1	Automotive Electrical and Electronics Laboratory	0	0	2	2
			TOTAL	9	2	2	12

SEMESTER III							
SL. NO	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	MAM302	Automotive Chassis	3	0	0	3
2	PC	MAM 303	Automotive Transmission	3	0	0	3
3	PC	MAM 304	Advanced Materials for Automotive Engineers	3	0	0	3
4	PC	MAM 301	Vehicle Management Systems	3	0	0	3
			TOTAL	12	0	0	12

SEMESTER IV							
SL. NO		COURSE CODE	COURSE TITLE	L	T	P	C
1	PC	MAM 404	Engine Management Systems	3	0	0	3
2	PE	MAM 4E1	Professional Elective -I	3	0	0	3
3	PE	MAM 4E2	Professional Elective -II	3	0	0	3
PRACTICAL							
4	PC	MAM4L1	Computer Aided Vehicle Design Lab	0	0	3	2
			TOTAL	9	0	3	11

SEMESTER V							
SL. NO	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PE	MAM 5E3	Professional Elective -III	3	0	0	3
2	OE	MAM 5E4	Professional Elective - IV	3	0	0	3
PRACTICAL							
3	PR	MAM5P1	Project Work – Phase I	0	0	6	6
			TOTAL	6	0	6	12

SEMESTER VI							
SL. NO	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL							
1	PR	MAM6P1	Project Work - Phase II	0	0	12	12
			TOTAL	0	0	12	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 73

LIST OF ELECTIVES (Elective I to IV)					
Professional Elective –I					
MAM001	Rubber Technology for Automobiles	3	0	0	3
MAM002	Noise vibration and Harshness	3	0	0	3
MAM003	Transport management and Motor Industry	3	0	0	3
MAM004	Advanced Manufacturing Processes	3	0	0	3
Professional Elective –II					
MAM005	Automotive Air-conditioning systems	3	0	0	3
MAM006	Automotive Aerodynamics	3	0	0	3
MAM007	Tyre Technology	3	0	0	3
MAM008	Simulation of Vehicle Systems	3	0	0	3
Professional Elective –III					
MAM009	Alternative Fuels and Propulsion Systems	3	0	0	3
MAM010	IC Engine Process Modeling	3	0	0	3
MAM011	Vehicle Maintenance	3	0	0	3
MAM012	Computer Aided Design (CAD)	3	0	0	3
Open Elective –IV					
MST070	Research Methodology	3	0	0	3
MAM014	Electric and Hybrid Vehicles	3	0	0	3
MAM015	Instrumentation and Experimental Techniques	3	0	0	3
MAM016	Quality Control and Reliability Engineering	3	0	0	3

MMA 102		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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

MAM 101	THERMAL ENGINEERING		L	T	P	C
	Total Contact Hours: 60		3	2	0	4
	Prerequisite: Engineering Thermodynamics, Heat and Mass Transfer, Internal Combustion Engines and Refrigeration And Air Conditioning					
	Course Designed by : Department of Automobile Engineering					
OBJECTIVES • To integrate the concepts, laws and methodologies from the first course in thermo dynamics into analysis of cyclic processes • To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems.						
COURSE OUTCOMES (COs)						
CO1	To Know the basics on Combustion, IC Engines Processes and Thermodynamic reactions					
CO2	To Learn the Phenomena of Chemical Reactions and Kinematics of Combustion					
CO3	To Learn about various types of Turbines, Steam nozzles and Governors					
CO4	To Know about various types of Compressors and Efficiency Parameters					
CO5	To Learn about refrigeration cycles and to solve the problems on Psychometry					
Mapping of Course Outcomes with 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I THERMODYNAMICS OF COMBUSTION 12

Premixed and diffusion combustion process in IC engines and gas turbines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and droplet combustion.

UNIT II CHEMICAL KINETICS OF COMBUSTION 12

Fundamentals of combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion.

UNIT III STEAM NOZZLES AND TURBINES 12

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV AIR COMPRESSOR 12

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT V REFRIGERATION AND AIR CONDITIONING 12

Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems (Description only) - Alternate refrigerants – Comparison between vapour compression and absorption systems - Air conditioning system: Types, Working Principles - Psychrometry, Psychrometric chart - Cooling Load calculations - Concept of RSHF, GSHF, ESHF -(Use of standard thermodynamic tables, Mollierdiagram, Psychrometric chart and refrigerant property tables are permitted in the examination)

TEXT BOOKS:

1. Sarkar, B.K., "Thermal Engineering" Tata McGraw-Hill Publishers, 2007.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar. A.V., "A course in thermal engineering," Dhanpat Rai & sons, Fifth edition, 2002.

REFERENCES:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000.
2. Arora.C.P., "Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 1994.
3. Ganesan V. . "Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007.
4. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2003.

MAM 102		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

MAM 1L1		AUTOMOTIVE ENGINES LAB				L	T	P	C
		Total Contact Hours: 45				0	0	2	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

LIST OF EXPERIMENTS

1. Performance Test of SI Engine.
2. Performance Test of CI Engine.
3. Determination of pressure crank angle diagram in IC Engines.
4. Heat balance test on IC engines
5. Performance test on variable compression ratio multi fuel diesel engine.

6. Assembling and dismantling of the following

- (i) Fiat engine.
- (ii) CI-Ashok Leyland engine
- (iii) Single plate, Diaphragm Clutch.
- (iv) Constant mesh, Sliding mesh gear box
- (v) Transfer case
- (vi) Differential
- (vii) Front axle, Rear axle
- (viii) Brakes system
- (ix) Steering system

MAM 201		<u>AUTOMOTIVE ELECTRICAL AND ELECTRONICS</u>				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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

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

MAM 202		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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's seat 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

MAM 203	VEHICLE DYNAMICS			L	T	P	C
	Total Contact Hours: 60			3	2	0	4
	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	37 th , 38 th & 39 th 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

MAM 2L1		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 visualizethe 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

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

MAM 302	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 analyze its braking performance with tests.						
CO5	To study on suspension system with its type along with the construction of tyres and 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 SYSTEMS

14

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.

MAM 303		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

MAM 304		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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, vinylidene 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.

MAM 301		VEHICLE MANAGEMENT SYSTEMS				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Basic Electrical and Electronics, Automotive chassis and Control and Computer Control of Vehicle Systems							
		Course Designed by : Department of Automobile Engineering							
OBJECTIVES									
To explain the principle of chassis management system and different sensors used in the systems. Students be knowledge on interfacing of different sensors and actuators used in the automobile systems.									
COURSE OUTCOMES (COs)									
CO1		To Know the basics onComponents of chassis management system							
CO2		To Know about the role of Sensors and Actuators in Driveline Control system							
CO3		To study and to know about the Safety and Security Systems installed in the vehicle.							
CO4		To study and to know about the comfort systems present in a vehicle with electronic management systems							
CO5		To study on the Intelligent transportation systems with Data communication modes							
Mapping of Course Outcomes with 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Components of chassis management system – role of various sensors and actuators pertain to chassis system – construction – working principle.

UNIT II DRIVELINE CONTROL SYSTEM

9

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - power steering, collapsible and tiltable steering column – steer by wire.

UNIT III SAFETY AND SECURITY SYSTEM

9

Airbags, seat belt tightening system, collision warning systems, child Lock, Anti-lock braking systems, Vision enhancement, road recognition system, Anti-theft technologies, smart card system, number plate coding, central locking system.

UNIT IV COMFORT SYSTEM

9

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

UNIT V INTELLIGENT TRANSPORTATION SYSTEM

9

Traffic routing system - Automated highway systems - Lane warning system – Driver Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems – vision enhancement system - In-Vehicle Computing – Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, New Delhi, 2002.
2. William B. Ribbens -Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn, 1998.
3. Bosch, “Automotive Handbook”, 6th edition, SAE, 2004.
4. Internet References

MAM 404	ENGINE 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 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

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 DIGITAL ENGINE CONTROL SYSTEM 9

Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control – Integrated engine control system, Exhaust emission control engineering, and Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis 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

MAM 4L1		COMPUTER AIDED VEHICLE DESIGN LABORATORY				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			

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

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.

MAM 6P1		PROJECT WORK – 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 rejuvenate 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 Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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

PROFESSIONAL ELECTIVE-I

MAM 001		RUBBER TECHNOLOGY FOR AUTOMOBILES			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								
At the end, the student will have good exposure to role of various Rubber components in Automobiles.								
COURSE OUTCOMES (COs)								
CO1		To know and to Identify the utilization of plastics and rubber components in automobile systems						
CO2		To know and to understand the Structure with their properties in relationship to rubber						
CO3		To study about the properties of the spring in accordance with their characteristics						
CO4		To study about the flexible sealings, hoses and couplings employed in automobiles						
CO5		To study about the various couplings and their usage 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		

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

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, 1992.
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

MAM 003		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 taxis 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.

UNIT I - ADVANCES IN CASTING

9

Newer casting techniques - Expendable pattern casting - Plaster mold and ceramic mold casting – Vacuum casting - Squeeze casting - Rapid solidification for amorphous alloys – Casting techniques for single crystal components.

UNIT II -ADVANCED FORMING AND POWDER METALLURGY PROCESSES

9

High speed forging machines - Die materials - semisolid metal forming- Peen forming of sheet metals - Super plastic forming – Forming and shaping glass. Design consideration for Powder Metallurgy forming - Production of metal powders – Compaction – Sintering – Finishing of sintered parts – Secondary and finishing operations.

UNIT III - FABRICATION OF MICRO ELECTRONIC DEVICES

9

Semiconductors and silicon - Crystal growing and wafer preparation - Film deposition, Oxidation, Lithography, Etching, Diffusion and ion implantation, Metallization and testing - Bonding and packing.

UNIT IV - MANUFACTURING OF COMPOSITES

9

Introduction- Fibre reinforced, Metal matrix, Ceramics matrix composites, Nanocomposites - structure, Properties, manufacturing processes and applications.

UNIT V - RAPID PROTOTYPING

9

Rapid prototyping- overview, Techniques-Stereo lithography, Laminated object manufacturing, Selective laser sintering, fused deposition modeling, solid ground curing, 3D ink jet printing-Applications of rapid prototyping-Rapid tooling-Rapid manufacturing-Future development-Virtual prototyping.

TEXT BOOKS

1. Serope Kalpakjian, “Manufacturing Engineering and Technology”, 3rd Edition, Addison-Wesley Publishing Co., Boston, 2009.
2. Madou M. J, “Fundamentals of micro fabrication and nanotechnology”, 3rd edition, CRC Press, USA, 2011.

REFERENCES

1. Amstead B. H, Ostwald Phillips and Bageman R.L, “Manufacturing Processes”, John Wiley & Sons, New York, 1987.
2. Jaeger R.C, “Introduction to microelectronic Fabrication”, Addison Wesley, Boston, 1988.
3. Chua C. K, “Rapid Prototyping - Principles and Applications”, World Scientific Publishing Company, 2010.
4. Hilton P. D and “Marcel Dekker”, Rapid Tooling, New York, 2000.

LIST OF ELECTIVES-II

PROFESSIONAL ELECTIVE-II

MAM 005		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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.

9

UNIT – III AIR CONDITIONER – HEATING SYSTEM

10

UNIT – IV AIR ROUTING & TEMPERATURE CONTROL

10

UNIT – V HEATER – AIR CONDITIONER TROUBLE SHOOTING & SERVICE 6

f

TEXT BOOK:

- ## REFERENCES:

MAM 006	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 the forces 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

REFERENCES:

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Houghton, Aerodynamics

MAM 007		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016								

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 extrusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile – critical dimensions. Dual 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.

MAM 008		SIMULATION OF VEHICLE SYSTEMS				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									
The objective of this course is to introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tire system etc.									
COURSE OUTCOMES (COs)									
CO1		To Know about basics of Vehicle systems and Driveline dynamics							
CO2		To Know about the Lateral dynamics and Electronic Stability control							
CO3		To study about the concept involved in themodelling of passive automotive suspensions							
CO4		To study about the concept involved in themodeling of semi active and active automotivesuspensions							
CO5		To study and to learn about the lateral and longitudinal tire forces acting on a 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	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I LONGITUDINAL DYNAMICS AND CONTROL

9

Aerodynamic drag force - Longitudinal tire force - Rolling resistance - Calculation of normal tire forces - Calculation of effective tire radius - Driveline Dynamics - Torque converter - Transmission dynamics - Engine dynamics - Wheel dynamics - Cruise Control - Anti-Lock Brake Systems - Automated Highway Systems - Longitudinal Control Architecture.

UNIT II LATERAL DYNAMICS AND ELECTRONIC STABILITY CONTROL

9

Lateral Systems - Kinematic Model - Bicycle Model. Motion of Particle Relative to a rotating Frame. Dynamic Model in Terms of Error with Respect to Road, Yaw Rate and Slip Angle. Road Model. Differential Braking Systems - Steer-By-Wire Systems - Independent All Wheel Drive Torque Distribution

UNIT III MODELING OF PASSIVE AUTOMOTIVE SUSPENSIONS

9

Introduction - Modal Decoupling - Performance Variables - Natural Frequencies and Mode Shapes - Approximate Transfer Functions - Analysis of Vibrations in the Sprung Mass Mode and Unsprung Mass Mode - Verification Using Quarter Model. Half-Car and Full-Car Suspension Models.

UNIT IV MODELING OF SEMIACTIVE AND ACTIVE AUTOMOTIVE SUSPENSIONS

9

Semi-Active Suspension Model - Optimal Semi-Active Control Law - Calculation of Transfer Function Plots - Performance of Semi-Active Suspension Systems. Active Automotive Suspensions - Trade-offs and Limitations - Invariant Points and Their Influence - Hydraulic Actuators for Active Suspensions

UNIT V LATERAL AND LONGITUDINAL TIRE FORCES

9

Tire Forces - Tire Structure - Longitudinal Tire Force at Small Slip Ratios - Lateral Tire Force at Small Slip Angles - Magic Formula Tire Model - Dugoff's Tire Model - Dynamic Tire Model - Development of Lateral Tire Model for Uniform Normal Force Distribution and Parabolic Normal Pressure Distribution - Combined Lateral and Longitudinal Tire Force Generation.

TEXT BOOK

- 1) Rajesh Rajamani, "Vehicle Dynamics and Control", Springer, 2006.

LIST OF ELECTIVES-III

PROFESSIONAL ELECTIVE-III

MAM 009		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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.

MAM 010	IC ENGINES PROCESS MODELING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: IC Engines, Engine Management Systems, Automotive Engines							
	Course Designed by : Department of Automobile Engineering							
OBJECTIVES								
The objective of this course is to introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tire system etc.								
COURSE OUTCOMES (COs)								
CO1	To Know about basics of Vehicle systems and Driveline dynamics							
CO2	To Know about the Lateral dynamics and Electronic Stability control							
CO3	To study about the concept involved in themodelling of passive automotive suspensions							
CO4	To study about the concept involved in themodeling of semi active and active automotivesuspensions							
CO5	To study and to learn about the lateral and longitudinal tire forces acting on a 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	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I INTRODUCTION

9

Introduction to simulation, advantages of computer simulation, classification of engine models. Intake and exhaust flow models, quasi steady flow, filling and emptying, gas dynamic models. Thermodynamic based in cylinder models. Step by step approach in SI engine simulation.

UNIT – II COMBUSTION AND STOICHIOMETRY

9

Reactive processes, heat of reaction, measurement of URP, measurement of HRP. Introduction combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

UNIT – III ADIABATIC FLAME TEMPERATURE

9

Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI engine simulation with air as working medium, deviation between actual and ideal cycle.

UNIT – IV SI ENGINE SIMULATION WITH ADIABATIC COMBUSTION

9

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. Wiebe's law combustion analysis.

UNIT – V SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS

9

Introduction, gas exchange process, heat transfer process, friction calculations, 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.

TEXTBOOKS:

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.
2. Bechtold, R.L., Alternative Fuels Guide Book, SAE, 1997.

REFERENCES:

1. Ganesan. V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd,

2. John. B. Heywood, "Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.
3. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
4. Ramoss. A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
5. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.

MAM 011		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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.

MAM 012		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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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.

LIST OF ELECTIVES-IV

PROFESSIONAL ELECTIVE-IV

MST070		RESEARCH METHODOLOGY				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Operation Research, Human Resource management, Professional Ethics and Industrial Management							
		Course Designed by : Department of Automobile Engineering							
OBJECTIVES									
To Know the conceptual design of research process and its methodology with usage of statistical tools and sampling techniques. The students should able to know the process of report writing and usage of Statistical tools in their research.									
COURSE OUTCOMES (COs)									
CO1		To Understand the concept and design of research process and its methodology							
CO2		To Study and to know about the sampling methods and the measurement techniques							
CO3		To Understand the method of data collection and experimentation techniques							
CO4		To Study and to learn the parametric and non-parametric tests							
CO5		To learn report writing along with execution of statistical techniques and evolve research 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	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I RESEARCH PROCESS AND DESIGN

9

Scientific thinking; Reasoning and Scientific attitude. What is Research? Research Process; Research need, formulating the problem, designing, sampling, Pilot testing, data collection, analysis and interpretation and report. Research design: Exploratory, Descriptive, Causal, Formulation of

MAM 014	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 the configuration 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I ELECTRIC VEHICLES

6

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II 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 Vehicles – Design Fundamentals, CRC Press.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles.

MAM 015		INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES				L	T	P	C
		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Basic Electrical and Electronics, Microprocessor Applications Automotive Electrical systems and Electronics and Instrumentation							
		Course Designed by : Department of Automobile Engineering							
OBJECTIVES									
To understand the concepts involved in electronics and Instrumentation with its application on automobile systems. The students should be more capable to learn the modern technological improvements in instrumentation which directly favors the development of Automotive systems									
COURSE OUTCOMES (COs)									
CO1		To know about the various types of measurement systems							
CO2		To Study the concept of transducers, modifiers and terminating devices							
CO3		To Learn about the instruments used for mechanical measurement							
CO4		To study the engine experimental techniques and electronic measuring devices							
CO5		To Study and to conduct vehicle experimental 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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT – I MEASUREMENT SYSTEMS

6

Static and Dynamic Measurement systems- Requirement and characteristics- Analysis of experimental detail, Error analysis.

UNIT – II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES

8

Transducers for Automotive Applications- Amplifiers- Filters- Data Acquisition- Indicators, Printers and Displays- Signal Analyzing.

UNIT – III MECHANICAL MEASUREMENT

10

Instrumentation for Measuring weight, Force, Torque, Pressure Power, Temperature, Fluid flow, Vibration, Rotational speed, Velocity, Acceleration and Angular motion.

UNIT – IV ENGINE EXPERIMENTAL TECHNIQUES

12

I S Code for Engine testing- Instrumentation for Performance testing of engine- Instrumentation for Research and Development, Instrumentation for noise, vibration, in cylinder gas flow, Flame temperature dynamic cylinder pressure measurements.

UNIT – V VEHICLE EXPERIMENTAL TECHNIQUES

9

Laboratory tests- Tests tracks-Endurance tests-Crash tests- Wind tunnel tests-Brake tests.

TEXTBOOK:

1. J.G. Giles, "Engine and Vehicle Testing", Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, "Mechanical Measurements", Oxford and IBH Publishing House, New Delhi,1995

REFERENCE:

1. A.W. Judge, "Engineering Precision Measurement", Chapman and Hall Ltd, Essex Street W.C., 1951.
2. D.Patambis. "Principle of Industrial Instrumentation", Tata McGraw Hill Publishing Company, New Delhi, 1990.
3. Rangan, Sharma and Mani, "Instrumentation Devices and Systems ", Tata McGraw Hill Publishing Company, New Delhi, 1990.

MAM 016	QUALITY CONTROL AND RELIABILITY					L	T	P	C
	Total Contact Hours: 45					3	0	0	3
	Prerequisite: Industrial Engineering, Operation Research and Total Quality management								
	Course Designed by : Department of Automobile Engineering								
OBJECTIVES									
To understand the concept of Statistical techniques involved in the controlling quality and maintain reliability with analyzing failures. Students can able to know the purpose of employing Statistical techniques to maintain reliability aspects with enhanced quality of a product									
COURSE OUTCOMES (COs)									
CO1	To know about the basicSQC tools and Charts								
CO2	To Study the concept of acceptance sampling methods and standards								
CO3	To Learn about reliability engineering								
CO4	To understand and to check the reasons for failure through analyzing the data								
CO5	To Study about the concept of reliability prediction and 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			
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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I - STATISTICAL QUALITY CONTROL

9

Methods and Philosophy of Statistical Process Control - Control Charts for Variables and Attributes –Cumulative sum and Exponentially weighted moving average control charts -Other SPC Techniques – Process - Capability Analysis Six sigma concept.

UNIT II - ACCEPTANCE SAMPLING

9

Acceptance Sampling Problem - Single sampling plans for attributes – double sampling -multiple sampling - sequential sampling - Military standards - The Dodge Roming sampling plans – Random sampling.

UNIT III - RELIABILITY ENGINEERING

9

Definition of reliability – Performance and reliability - Reliability requirements – System life cycle – Mean time between failures – Mean time to failure - Mortality Curve -Availability – Maintainability.

UNIT IV - FAILURE DATA ANALYSIS

9

Statistical failures of components – failure distributions – Bath tub curve – Negative exponential distribution – Normal distribution - log normal distribution – Gamma distribution - Weibull distribution Life distribution measurements – Accelerated life tests -Data requirements for reliability.

UNIT V - RELIABILITY PREDICTION AND MANAGEMENT

9

Failure rate estimates - Effect of environment and stress - Series and Parallel systems -RDB analysis – Standby Systems - Complex Systems - Reliability demonstration testing- Reliability growth testing - Duane curve - Risk assessment – FMEA and Fault tree analysis.

TEXT BOOKS:

1. Khanna O.P, “Statistical Quality Control”, Dhanpat Rai Publications (P) Ltd., 2001.
2. Lewis E.E, “Introduction to Reliability Engineering”, John Wiley and Sons, 1987.

REFERENCES:

1. Mohamed Zairi, “Total Quality Management for Engineers”, Woodhead Publishing Limited 1991.
2. Harvid Noori and Russel, “Production and Operations Management – Total Quality and Responsiveness”, McGraw-Hill Inc, 1995.
3. Douglas C. Montgomery, “Introduction to Statistical Quality Control”, 2nd Edition, John Wiley and Sons, 1991.

CURRICULUM AND SYLLABUS (R2015)**CHOICE BASED CREDIT SYSTEM****M.TECH – MACHINE DESIGN (FULL TIME)****I – IV SEMESTERS**

SEMESTER – I							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MMA105	PM	Applied Mathematics	3	0	0	3
2	MMD101	PC	Mechanical Vibrations	3	0	0	3
3	MMD102	PC	Advanced Strength of Materials	3	0	0	3
4	MMD103	PC	Design of Mechanisms-I	3	0	0	3
5	MMD104	PC	Finite Element Analysis	3	0	0	3
6	MMD105	PC	Engineering Design	3	0	0	3
7	MMD1L1	PC	Mechanisms, Machine Elements and CAD Lab	0	0	4	2

TOTAL CONTACT HOURS-22**TOTAL CREDIT: 20**

SEMESTER – II							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MMD201	PC	Advanced Design of Transmission system	3	0	0	3
2	MMD202	PC	Tribology	3	0	0	3
3	MMD203	PC	Design of Pressure Vessels and Piping	3	0	0	3
4	MMD204	PC	Design of Mechanism – II	3	0	0	3
5	MMD205	PC	Machine Tool Design	3	0	0	3
6	MMD206	PC	Design Of Hydraulic And Pneumatic System	3	0	0	3
7	MMD2L1	PC	Design and Analysis Lab	0	0	4	2

TOTAL CONTACT HOURS-22**TOTAL CREDIT: 20****SEMESTER – III**

S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MMD3E1	PE	Professional Elective – I	3	0	0	3
2	MMD3E2	PE	Professional Elective - II	3	0	0	3
3	MMD3E3	OE	Open Elective	3	0	0	3
4	MMD3P1	PR	Project Work Phase I	0	0	12	6

TOTAL CONTACT HOURS-21**TOTAL CREDIT: 15**

SEMESTER – IV							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C

1	MMD4P2	PR	Project Work Phase II	0	0	24	12

TOTAL CONTACT HOURS-24

TOTAL CREDIT: 12

TOTAL PROGRAMME CREDITS: 67

**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 Mathematics (PM)	3	-	-	-	3	4.45%
2	Professional Core (PC)	17	20	-	-	37	55.22%
3	Professional Electives (PE)	-	-	6	-	6	8.96%
4	Open Electives (OE)	-	-	3	-	3	4.45%
5	Project Work, Seminar, Internship, etc. (PR)	-	-	6	12	18	26.87%
	Total Credit	20	20	15	12	67	100%
	Total Contact Hour	22	22	21	24	89	

LIST OF ELECTIVES

Professional Elective –I

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MMD 001	Vibration Control And Condition Monitoring	3	0	0	3
2	MMD002	Design Of Material Handling Equipments	3	0	0	3
3	MMD006	Composite Materials And Mechanics	3	0	0	3
4	MCD 101	Integrated product design & development	3	0	0	3
5	MCD 202	Computer Aided Manufacturing	3	0	0	3
6	MCD203	Computer Applications Design	3	0	0	3
7	MCD 204	Computer Aided Machine Element Design	3	0	0	3

Professional Elective –II

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MMD 003	Tool Design	3	0	0	3
2	MMD 004	Design of jigs and fixtures	3	0	0	3
3	MMD 005	Engineering Fracture Mechanics	3	0	0	3
4	MCD 003	Design For Manufacturing	3	0	0	3
5	MCD 004	Production And Operation Management	3	0	0	3
6	MCD 102	Computer Graphics	3	0	0	3
7	MCD 201	Optimization In Mechanical Engineering	3	0	0	3

Open Elective

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MAE002	Robotics	3	0	0	3
2	MCS157	System Modeling And Simulation	3	0	0	3
3	PCD 005	Mechatronics	3	0	0	3
4	HST070	Research Methodology	3	0	0	3
5	MMD 007	Advanced Material Science And Failure Analysis in Mechanical Design	3	0	0	3

Course	Course Name: APPLIED MATHEMATICS				L	T	P	C
Code	Total Contact Hours:45				3	0	0	3
MMA105	Prerequisite: Engineering Mathematics I, Engineering Mathematics II Engineering Mathematics III							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES								
The main objectives of the course are to enhance the knowledge of various methods in finding Eigen values and Eigen vectors of matrix, and also to evaluate differentiation of complex funct with a greater accuracy to formulate Problems in engineering and solve them analytically numerically								
COURSE OUTCOMES (COs)								
CO1	Compute Eigen Vectors For Given Matrix By Different Methods							
CO2	Solve Vibration Problem By Different Methods							
CO3	Convert Boundary Value Problems Into Integral Equations And Find Solutions							
CO4	Apply Probability Concepts To Arrive Engineering Solutions							
CO5	To Understand And Apply Principal Of Probability In Solving Mechanical Engineeri 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		
2	CO1	L				H		
	CO2		H					
	CO3			M				
	CO4			L				
	CO5				M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship		
		√						

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

UNIT – 1 ADVANCE MATRIX THEORY

9

Eigen values using QR transformation – Generalized Eigen vectors – canonical forms – singular valued decomposition and application – matrix norms and induced norms – Pseudo inverse – Least approximations.

UNIT – II CALCULUS OF VARIATIONS

9

Variation and its properties – Euler’s Equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Constraints in the form of a functional isoperimetric problems – Direct method – Ritz Kantorovich methods – Boundary value problems.

UNIT – III TRANSFORM METHOD

9

Laplace transform methods for one dimensional wave equation – displacement in a line string – Longitudinal vibrations of elastic bar – Fourier transform methods for one dimensional heat conduction problems in infinite and semi infinite rod.

UNIT IV PROBABILITY

9

Probability concepts – Random Variables – Discrete and continuous distributions correlations – Partial, Multiple, Rank – Analysis of Variance – One way, two way classification.

UNIT V CURVE FITTING

9

Trend analysis – Regression – Multiple regressions – polynomial fitting Estimation – Point and interval Estimates

Total Periods: 45

REFERENCES:

1. Sankara Rao K. Introduction to Partial differential equation – Prentice Hall of India – New Delhi 1995.
2. Elsgotis, Differential Equations and Calculus of variations, MIR Publishers Moscow.
3. Freund JE and Miller JR, ‘Probability and Statistics for Engineers’ – Prentice Hall of India 5th edition New Delhi 1994.

Course Code MMD101	Course Name: MECHANICAL VIBRATIONS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES The course should enable the students to: Understand the sources of vibration and noise in automobiles and make design modifications Learn to reduce the vibration and noise and improve the life of the components					
COURSE OUTCOMES (COs)					
CO1	Understand the causes and effects of vibration in mechanical systems and their Classification.				

CO2		Develop schematic models for physical systems and formulate governing equations of motion.				
CO3		Understand the role of damping, stiffness and inertia in mechanical systems				
CO4		Analyze rotating and reciprocating systems and design machine supporting structures, vibration isolators and absorbers				
CO5		Calculate free and forced vibration responses of multi degree freedom systems using modal 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	L				S
	CO2		H			
	CO3			M		
	CO4		L		M	
	CO5	M				L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I ONE DEGREE OF FREEDOM SYSTEMS

9

Vibration principle – Equilibrium & Energy methods – Free vibration – Viscous & Coulomb damping – Forced vibration – Base excitation – Transmissibility – Resonance Characteristics.

UNIT – II TWO DEGREES OF FREEDOM SYSTEMS

9

Two degrees of freedom – Matrix form – Undamped free vibration – Principal modes – Coordinate coupling – Principal coordinates – Torsional vibrations – Holzer method – Work & Energy approach.

UNIT – III TRANSFER VIBRATIONS

9

Transient vibration – Time dependency – Laplace transforms – Step inputs – Pulse inputs – impulse function – Duhamel's integral – Phase plane method – Shock spectrum.

UNIT IV MULTIDEGREE OF FREEDOM SYSTEMS

9

Multi degrees of freedom – Equations of motion – Solution – Orthogonality of normal modes – Continuous systems – Free & forced vibrations – Vibration analysis by FEM.

UNIT V VIBRATION MEASURING SYSTEMS

9

Vibration instruments – Vibration absorber – Elastically supported dampers – Seismic instruments – Vibrometers – Pickups – Accelerometers – Mounting instruments – Amplitude & phase distortions.

Total Periods: 45

Reference :

1. W T Thomason – Theory of Vibrations – Uniwin Hyman Ltd/CBS publishers. 1990.

2. Francis S. Tse, Iran. E. Morse Rolland T. Hinkle – Mechanical vibrations – CBS Publishers 1993.
3. G.K. Grover – Mechanical vibrations – Namchands & Bros .1996
4. V.P. Singh – Mechanical vibrations - Dhanpat Rai & Co., 2000.
5. S.P. Timoshenko – Vibration problems in Engineering – CBS Publishers
- 6.S.S. Rao, Mechanical Vibration, Pearson Education, 1995.

Course Code MMD 102	Course Name: ADVANCED STRENGTH OF MATERIALS		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES To understand the strain/displacement and Hooke’s law relationships To solve torsion problems in bars and thin walled members To solve for stresses and deflections of beams under unsymmetrical loading To locate the shear center of thin wall beams						
COURSE OUTCOMES (COs)						
CO1	Understand and analyze stresses and strains at a point.					
CO2	Determine stress-strain relations for linearly elastic members using normal stress, shear Stress and distortion energy theories					
CO3	Model and analyze mechanical structures using energy methods					
CO4	Design straight beams, curved and asymmetrical bending of beams					
CO5	: Analyze and determine beams under unsymmetrical loading.					
Mapping of Course Outcomes with 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	L				S
	CO2		H			
	CO3			M		
	CO4		L		M	
	CO5	H				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I UNSYMMETRIC BENDING AND SHEAR CENTER

9

Unsymmetric bending of straight beams – Generalised theory – Bending stresses deflection – Transverse shear stress – shear centers of thin walled sections.

UNIT – II CURVED FLEXURAL MEMBERS

9

Circumferential stress – Radial stresses and Shear stress – Closed rings subjected to concentrated loads – Crane hooks – Chain links.

UNIT – III TORSION AND CONTACT STRESSES

9

Saint Venant theory – Membrane analogy – Thin walled open sections – Thin walled multicell tubes – Warping of thin walled open and closed cross sections – Contact stresses – Spheres and Cylinders.

UNIT – IV STRESSES DUE TO ROTATION, FLAT PLATES

9

Spinning disks – Flywheels – Flat disks - Variable thickness – Uniform strength – Allowable speeds, Symmetrically loaded circular plate, Circular plate freely supported at its circumference. Circular plate with central hole. Freely supported at its circumference. Circular plate clamped at its circumference, bending of rectangular plates.

UNIT – V THEORY OF ELASTICITY

9

General Equations of Elasticity – Cartesian and Polar – Equilibrium and stresses – Compatibility of Strains – Boundary conditions – Stress tensors- Saint Venant's Principles – Plane stress – Plane strain- Airy stress function.

Total Periods: 45

References:

1. Budynas – Advanced Strength and Applied Stress Analysis – Tata Mc Graw Hill, 1999.
2. R.D. Cook W.C. Young – Advanced Mechanics of Materials – Prentice Hall 1999.
3. S. P. Timoshenko J.N. Goodier – Theory of Elasticity – McGraw Hill, 1987.
4. S. P. Timoshenko – Strength of Materials – TMH 1986
5. B.C. Punmia – Strength of Materials and Mechanics of Structures 1996

Course Cod MMD103	Course Name: DESIGN OF MECHANISMS – I		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To include dynamics considerations in the design of mechanisms for engineering applications is the objective of this course.						
COURSE OUTCOMES (COs)						
CO1		Understand basic principles of Mechanism and machines.				
CO2		Develop schematic models for physical systems and formulate governing equations of motion				
CO3		Understand the three dimensional linkages and coupler curves				
CO4		Understand and Analyze the various gear trains				
CO5		Understand the principles of cam 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
2	CO1	L				S
	CO2		H			
	CO3			M		
	CO4					L
	CO5				H	

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

UNIT – I MECHANISMS & MACHINES BASIC CONCEPTS 9

Mechanism – Tools for design of linkages & other mechanism – DOF (mobility) – transmission angle – Grashoff criterion – Quick return mechanism – Limiting positions – Mechanism for specific applications.

UNIT – II ANALYSIS OF MECHANISMS 9

Displacement analysis of linkages – Complex number methods applied to velocity analysis – Analyzing combinations of basic linkages – Trial solutions & inverse methods – Acceleration analysis – Analysis of a four bar linkage using analytical vector method – Spatial linkage – Types – Analysis of four link spatial linkages.

UNIT – III 3D GEOMETRY & SPATIAL MECHANISM 9

Three dimension & its Cartesian system – Algebraic Surfaces & Special curves – Algebraic special linkages – Quadratic surfaces – Ruled surfaces – Degree of ruled surfaces – Curvature of surface & spatial curves – Special coupler curves.

UNIT – IV DRIVE TRAINS – DESIGN & ANALYSIS 9

Velocity ratios for Spur & Helical gear trains – Speed ratio – Planetary gear trains – Other gear train elements – Velocity & Acceleration a planetary train – Forces, torque & Transmitted power in gear trains.

UNIT – V CAMS & GEARS – DESIGN & ANALYSIS 9

Graphical cam design – Analysis of cam follower motion – Analytical cam design – Practical considerations in cam design – Fundamental law of gearing – Sliding action of gear tooth forces. Advanced cam profile techniques – Graphical & Analytical cam profile synthesis – Cam modulated linkages.

Total Periods: 45

References:

1. Arthur G. Erdman, George N. Sanctor – Mechanism Design Vol I & II Prentice Hall – 1997.
2. Charles E. Wilson J. Peter Seidler – Kinematics & Dynamic of Machinery, Second Edition.
3. K H. Hurt – Kinematic Geometry of Mechanisms, Oxford University Press 1978.

Course Code MMD105	Course Name: ENGINEERING DESIGN	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					

This course enables the student to identify failure modes and evolve design by analysis methodology. Design against fatigue failure is given explicit attention.						
COURSE OUTCOMES (COs)						
CO1		Understand the ethics followed during Engineering Design process.				
CO2		Illustrate the methods to define the customer needs				
CO3		Identify the sources of information to support and accelerate Engineering design process				
CO4		Understand the intuitive and advanced methods used to develop and evaluate a concept				
CO5		Express the basic concept of Embodiment Design to translate conceptual designs to Engineering 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	L				H
	CO2		H			
	CO3			M		
	CO4		H			
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I MATERIALS SELECTION

9

Mathematical modeling – Dimensional Analysis – Simulation – Material Selection – Methods of Material Selection Process – Selection with Computer Aided databases – Material performance indices – Decision matrices – Material selection by Expert systems – Value analysis – Recycling – Materials in design – Design for Fatigue failure – Brittle fracture – Corrosion resistance – Brittle materials – Plastics.

UNIT – II PROCESS SELECTION

9

Role of processing in design o Design for Manufacturability & Assembly – Computer methods for DFM and DPA – Design for Casting – Forging- Sheet metal forming – Machining – powder Metallurgy – Welding Design for Heat treatment – Plastics processing – Residual stresses in design .

UNIT – III STATISTICS AND DESIGN

9

Engineering statistics & design – Probability – Errors & samples – Frequency distribution – Measure of central Tendency and Dispersion – Normal distribution – Weibull and other frequency distributions – Sampling distributions – Statistical tests of Hypotheses – Statistical intervals – Analysis of variance – Statistical design of experiment – Regression analysis .

UNIT – IV RELIABILITY AND QUALITY OF DESIGN**9**

Reliability theory – Design for reliability – FMEA – Fault free analysis – Defects and failure modes – Failure analysis – Design for safety – Quality control and assurance – Quality improvement – Statistical process control – Taguchi method – Design optimization.

UNIT – V COSTING IN DESIGN**9**

Decision making – Time value of Money – cost comparison – inflation – Sensitivity & Break even analysis – Categories of costs – Methods Costirntexes – Cost capacity factors – Estimating plant cost – Design to cost – Manufacturing costs – Value analysis in costing - over head costs – cost models – Life cycle costing.

Total Periods: 45**References:**

1. GEORGE.DIETER Engineering Design '3rd Edition – McGraw Hill international Editions-2000.
2. Michel F. Ashby. "Materials Selection in Machine Design ". II edition
3. Achinya Halder, Somkasam Mahadeven, "Probability, Reliability and "Statistical Methods in Engineering "", John Wiley and Sons.
4. Yousuf Haik, Engineering Design Process "", First Print 2003.

Course Code MMD104	Course Name: FINITE ELEMENT ANALYSIS		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures To present Finite element formulation using variational and weighted residual approaches To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress plane strain problems and 3-D solids, for thermal and dynamics problems						
COURSE OUTCOMES (COs)						
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 high 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
2	CO1	L				S
	CO2		H			
	CO3			M		
	CO4	L			M	
	CO5					

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

UNIT – I BASIC CONCEPTS

9

Field problems – elementary treatments – Elements & types – Mathematical modeling – Steady state problems – Propagation problems – Eigen value problems – Differential formulation – Variational methods – weighted residual methods – Convergence criteria – Error estimation.

UNIT – II PROCEDURES & INTERPOLATIONS

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.

UNIT III ELASTICITY PROBLEMS

9

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

9

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

9

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

Course Code MMD1L1	Course Name: MECHANISMS, MACHINE ELEMENTS & CAD LABORATORY.	L	T	P	C
	Total Contact Hours: 60	0	0	4	2
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				

OBJECTIVES						
For giving hand on experience of using modeling software’s like CAD, CAM						
For giving visual representation on different kinds of mechanism						
Teaching the various methods of vibration measurement.						
COURSE OUTCOMES (COs)						
CO1	Draw complex geometries of machine components in sketcher mode.					
CO2	Write programs to generate analytical and synthetic curves used in engineering practice.					
CO3	Generate freeform shapes in part mode to visualize components					
CO4	Create complex engineering assemblies using appropriate assembly constraints.					
CO5	:Understand Vibration measurements by using accelerometer, oscilloscope					
Mapping of Course Outcomes with 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				S
	CO2		H			
	CO3			M		
	CO4		M			
	CO5				H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. Analysis of quick return mechanism.
2. Analysis of slider crank mechanism
3. To determine the time – ratio and to draw the motion curves
 - Displacement Diagram - Time Vs Displacement Graph
 - Velocity Diagram - Time Vs Velocity Graph
 - Acceleration Diagram - Time Vs Acceleration Graph
4. To find out the Natural frequency of a beam to verify the Dunkerley's rule.
5. To study the forced vibrations for various amounts of damping and to plot a graph of Amplitude versus Frequency.
6. Vibration measurement using Accelerometer
7. Vibration measurement using Electrodynamics type pickup
8. Vibration measurement by Oscilloscope dual trace
9. Corrected Gears.

MACHINE ELEMENTS AND CAD:

1. Write a C program to analyze the following mechanism
 - a. Four bar mechanism
 - b. Slider crank mechanism
2. Write a C/C++ program for the following finite element method problems.
 - a. Simple problems involving axial members.

b. Simple problems involving beam elements

3. Creation of working drawings of components and preparation of assembly models of Knuckle joint. Universal joints, screw jack, Plumber block, machine vice, Lathe chuck, connecting rod, piston assembly etc. by using the following techniques.

4. Generation of solid models using (instructive solid geometry (CSG) and Boundary representation (B.Rep).

5. Draw the Shear force and bending moment diagrams for the following beams using ANSYS packages.

a). Simply supported beam (point load & uniform by distributed load).

b) Cantilever beam (point load & uniformly distributed load).

6. Determine the natural frequency using FEA.

7. Two –dimensional problems in static & dynamic analysis. Thermal and CFD.

8. Working with IGES files and importing solid models from IGES files.

Total Periods: 60

Course Code MMD201	Course Name: ADVANCED DESIGN OF TRANSMISSION SYSTEM		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To impart adequate knowledge in designing transmission machine elements such as spur gears, helical gears, worm gears and etc.						
The student will also learn some Case studies of Design of Power Transmission System [mechanical and hydraulic systems] to reinforce their concepts.						
COURSE OUTCOMES (COs)						
CO1		The students will be able to Select / Design of various Mechanical and hydraulic Power transmission system in real life industrial environment				
CO2		The students will be able to think logically to design the various Mechanical and hydraulic Power transmission system which will enhance the efficiency and effectiveness of the industries.				
CO3		: In general the students will be able face the challenges of the industrial environment by Selecting/ using the right drive or transmission element				
CO4		After learning this Course the student will understand the Detail Design Procedure the Transmission Systems – Mechanical, Hydraulic, Pneumatic general description and comparison.				
CO5		The student will also learn some Case studies of Design Of Power Transmission System [mechanical and hydraulic systems] to reinforce their concepts				
Mapping of Course Outcomes with 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
	CO2		H			
	CO3			M		
	CO4					

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

UNIT – I

Profile correction of gears – Types of corrected gearing – Design of internal 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.

UNIT IV

Design of friction drives - Rating of Spur, Helical and Worm gears.

UNIT – V

Design of Spur helical, bevel and worm gear speed reducers – Design of Bearing and shafts – Layout of the reducer. This unit should carry 40 marks).

References:

1. T.J. Prabhu, Design of transmission Elements 2002
2. Handbook of gear design – Maitra TMH, 1994.
3. PSG Design Data Book 2003.

Course Code MMD202	Course Name: TRIBOLGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To provide broad based understanding of the interdisciplinary subject ‘tribology’ and its technological significanceTo understand the nature of engineering surfaces, their topography and learn about surface characterization techniques.Tto learn about the contact of solid surfaces and their interactions.To understand the genesis of friction, the theories/laws of sliding and rolling friction.To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.					
COURSE OUTCOMES (COs)					
CO1	Will be able to apply the principles of lubrication, lubrication regimes, and theories				

	of hydrodynamic, elastic hydrodynamic and mixed / boundary lubrication					
CO2	Will have knowledge of tribo testing and experimental techniques in Tribology.					
CO3	Will have knowledge about tribological modeling and simulation					
CO4	To understand the genesis of friction, the theories/laws of sliding and rolling friction.					
CO5	To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear 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
2	CO1	H				H
	CO2		H			
	CO3			M		
	CO4					
	CO5	H			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I SURFACE FRICTION AND WEAR

11

Topography of the surfaces, . Surface features, surface interaction , Friction – Sliding and rolling friction – Friction properties of Metallic and non Metallic Materials – Friction in extreme conditions – Wear – Types – Mechanism – Wear resistance Materials – Surface treatment – Surface Modifications – Surface coatings.

UNIT – II ROLLING ELEMENT BEARINGS

12

Geometry And Kinematics – Material And Manufacturing Processes – Contact Stress – Hertzian stress equations – stresses and deflections – axial loads and rotational effects, life capacity – variable loads – oil films – effects – Rolling Bearing failure.

UNIT – III LUBRICATION THEORY

11

Lubricants and their properties – Reynolds equations – thermal, inertia and turbulent effects – elasto plasto and magneto hydrodynamic lubrication – hydrostatic lubrication – gas lubrication.

UNIT – IV DESIGN OF FLUID FILM BEARING

11

Design and performance – thrust and journal bearings – full. Partial, fixed and pivoted. Bearings. Lubrication flow and delivery – power loss – heat and temperatures rotating loads and dynamic loads – hydrostatic bearing design.

Total periods: 45

References:

1. CAMERON, A Basic Lubrication Theory”. ELLIS Herward LTD. UK. 1981.
2. WILLIAMS. J.A. “Engineering Tribology” Oxford Univ Press 1994.
3. Hulling.J. (Editor) – ‘Principles of Tribology’ Macmillan (1984).
4. PSG Design Data Book, 2003.

Course Code MMD203	Course Name: DESIGN OF PRESSURE VESSELS AND PIPING					L	T	P	C
	Total Contact Hours: 45					3	0	0	3
	Prerequisite:								
	Course Designed by : Dept. of Mechanical Engineering								
OBJECTIVES									
To understand the different types of stresses and their effects in pressure vessel.									
To understand the piping layout and the stresses acting on it.									
COURSE OUTCOMES (COs)									
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			
2	CO1	L				S			
	CO2		H						
	CO3			M					
	CO4	H			L				
	CO5								
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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 VESSELS 9

Introduction – Hoop, longitudinal & radial stresses – general theory of thin stresses – thin & thick cylinders – shell components – cylindrical shells – vessel heads – thermal stresses – discontinuity stresses in pressure vessels. Shrink fit – autofrettage – 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

Course Code MMD204		Course Name: DESIGN OF MECHANISM – II			L	T	P	C
		Total Contact Hours: 45			3	0	0	3
		Prerequisite:						
		Course Designed by : Dept. of Mechanical Engineering						
OBJECTIVES								
To impart adequate knowledge regarding various synthesis types, static and dynamic analysis different mechanism								
COURSE OUTCOMES (COs)								
CO1		Student can draw coupler curves of different mechanisms.						
CO2		Analyze forces on different part of mechanism						
CO3		Can Design robotics manipulators						
CO4		Can analyze forces on CAMS.						
CO5		Analyze velocity and acceleration of parts of machinery.						
Mapping of Course Outcomes with 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				S		
	CO2		H					
	CO3	L		M				
	CO4	H				L		
	CO5	M			M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					

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

UNIT – I SYNTHESIS

16

Synthesis types – number synthesis – two position synthesis – three position synthesis on / for four bar linkage – Velocity & Acceleration synthesis – function generator – Coupler curves.

UNIT – II FORCE ANALYSIS –STATIC & DYNAMIC

20

Basic principles of force analysis – Graphical force analysis – Analytical statics – forces in gear & cam mechanism – Dynamic analysis of four bar slider crank mechanism – Balancing of machinery – Rotors – Reciprocating machines – matrix method.

UNIT – III ROBOTIC MANIPULATORS

9

Robot terminology & Definitions – matrix method of analysis – transmission matrix – forward

Total Periods: 45

References:

1. Charles E. Wilson, J. Peter Seidler – Kinematics & Dynamics of Machinery Second Edition 1991.
2. K.H. Hury – Kinematic Geometry of Mechanisms Oxford University Press – 1978.
3. Arthur G. Erdoran, George N. Sanmids – Mechanism Design Vol I & II Prentice Hall – 1997.

Course Code MMD206	Course Name: DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To know the advantages and applications of Fluid Power Engineering and Power Transmission System.						
To learn the Applications of Fluid Power System in automation of Machine Tools and other Equipments						
COURSE OUTCOMES (COs)						
CO1		Identify hydraulic and pneumatic components.				
CO2		Ability to design hydraulic and pneumatic circuits				
CO3		Demonstrate good grounding in the subject area of fluid power				
CO4		Appreciate the circuits and feel the advantages over the similar mechanical systems				
CO5		Gain knowledge regarding the use of special control and regulation element				
Mapping of Course Outcomes with 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
	CO2		H			
	CO3			M		
	CO4					
	CO5	L		L		

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

UNIT – I PUMPS 3

Hydraulic power generator – selection and specification of pumps, pumps and characteristics.

UNIT – II HYDRAULIC ACTUATORS 5

Linear and Rotary Actuators – Selection, specification and characteristics.

UNIT – III CONTROL AND REGULATION ELEMENT 6

Pressure direction and flow control valves, relief valves, non return and safety valves, actuation systems.

UNIT – IV HYDRAULIC AND PNEUMATIC CIRCUITS 12

Reciprocation, quick return, sequencing circuits, synchronizing circuits, Accumulator circuits – industrial circuits – press circuits, Hydraulic milling machine, grinding, planning, copying, fork lift. Earth mover circuits – Design and selection of components – safety and emergency mandrels.

UNIT – V PNEUMATIC SYSTEMS AND CIRCUITS 10

Fundamentals – control elements. Position and pressure sensing – logic circuits – switching circuits, Fringe condition modules and these integration, sequential circuits – cascade methods – mapping methods – step counter method – compound circuits design, combination circuit design.

UNIT – VI INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 9

Pneumatic equipments – selecting of components – design calculations – application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC-low cost automation – Robotic circuits.

Total Periods: 45

References:

1. Antony Esposso “Fluid Power with Applications” Prentice Hall 1980.
2. DUDLEY T. A Pease and JOHN. J. PIPPENGER “Basic Fluid Power” Prentice Hall 1987.
3. Andrew Parr. “Hydraulic and Pneumatics” Jai Co Publishing House. 1999
4. Bolton W. ‘Pneumatic and Hydraulic Systems’ Butter Worth – Heinemann – 1997.
5. James L Johnson, Introduction to fluid power, Esver press 2003

Course Code MMD205	Course Name: MACHINE TOOL DESIGN	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					

Understand the importance of tool design for productive manufacturing and the basic procedure of tool design, drafting of tool drawing etc. Bring in the required properties in the tool material by proper selection and heat treatment appropriate to the cutting process adopted. Understand the concepts of tolerance and make use of gauges to measure the same Understand the design concepts of Jigs & Fixtures Get proper knowledge in the latest area of tooling for CNC machines						
COURSE OUTCOMES (COs)						
CO1	The conventional practice and procedures adopted for tools & Design such as problem statement, Drafting Hole location, Bush installation etc is understood					
CO2	The knowledge on materials for cutting tools, heat treatment required for different materials and different types of tools is obtained					
CO3	The design of dies, gauges and the importance of tolerance in the manufacturing and inspection of dies & gauges is understood					
CO4	Jig & Fixtures design for all type of machine tool is done appropriately.					
CO5	Tooling for CNC machine tools and automatic machine are also made effectively					
Mapping of Course Outcomes with 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	L				H
	CO2	M	H			
	CO3			M		H
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Course Code MMD2L1	Course Name: DESIGN AND ANALYSIS LAB		L	T	P	C
	Total Contact Hours: 60		0	0	4	2
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES Enhance interest in learning the design and analysis of components using software’s such as Pro-E, Ansys and MATLAB etc. Understand the various concepts of analysis of mechanical systems. Understand the concepts of finite element analysis involving mechanical, structural and thermal related problems						
COURSE OUTCOMES (COs)						
CO1		Develop the concepts and design the machine elements.				
CO2		Analyze any mechanical components and visualize the results.				
CO3		Take up any FEA related work and can solve it efficiently				
CO4		Can do c-program for different structures				
CO5		Can solve problems using MATLAB.				
Mapping of Course Outcomes with 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	L				H
	CO2		H			
	CO3			M		
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

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- Write a C program for
 - Truss Problems
 - Beam problems
 - Frame problems
- Deflection of beams
 - Simply supported beam
 - Cantilever beam.
- Combined loading problems, eccentric loading problem.
- Analysis of frames.
- Moment of Inertia and center of gravity of complex structure.
- Torsion of circular shaft.
- Stresses and strains for varying sections.
- Shell problems
- Vibration problems
- 3-D problems
- Using MATLAB
 - Determination of velocity and acceleration for simple mechanism
 - Solution to the position problem of a four bar linkage
 - Dynamic simulation of slider crank mechanism
 - Designing four bar mechanisms

Total no of periods: 60

Course Code MMD001	Course Name: VIBRATION CONTROL AND CONDITION MONITORING	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
Gain knowledge on fundamentals of various degrees of freedom. Understand the concept of active vibration control. Learn condition based maintenance principles and applications. Gain knowledge on dynamic balancing and alignment of machinery. Gain knowledge on vibration control.						
COURSE OUTCOMES (COs)						
CO1	Fundamentals of various degrees of freedom.					
CO2	Active vibration control.					
CO3	Condition based maintenance principles and applications.					
CO4	Dynamic balancing and alignment of machinery					
CO5	Vibration control.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4		M			
	CO5					H

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
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UNIT – I INTRODUCTION 9

Fundamentals of single degree of freedom systems – two degree of freedom systems – multi degree of freedom systems – continuous systems – determination of natural frequencies and mode shapes – numerical methods in vibration analysis.

UNIT – II VIBRATION CONTROL 9

Introduction – reduction of vibration at source – control of vibration – structural design – material selection – located additions – artificial damping – resilient isolation – vibration – isolation – vibration absorbers.

UNIT – III ACTIVE VIBRATION CONTROL 9

Introductions – concepts and applications – smart materials – types and characteristics smart structures – characteristic active vibration in smart structures.

UNIT – IV CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS 9

Introduction – condition monitoring methods – the design of information system, selecting methods of monitoring, machine condition monitoring and diagnosis – vibration severity criteria – machine maintenance techniques – machine condition monitoring techniques – vibration monitoring techniques – instrumentation systems – choice of monitoring parameter.

UNIT – V DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY 9

Introduction, Dynamic balancing of rotors, field balancing in one plane two planes and in several planes – machinery alignment, “Rough” alignment methods – the face peripheral dial indicator method – reverse indicator method.

Total Periods: 45

References:

1. SINGIRESU S. RAO “Mechanical Vibration” Addison – Wesley publishing co, 1995.
2. RAO. J.S. “Vibratory conditional monitoring of machines” CRC Press 2000.
3. J.O. Den hartog – “Mechanical Vibrations” “McGraw Hill Newyork, 1985.
4. SCIENCE ELSEVIER – “Hand Book of condition monitoring” ELSEVIER SCIENCE 1996.

Course Code MMD002	Course Name: DESIGN OF MATERIAL HANDLING EQUIPMENTS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					

To impart adequate knowledge regarding the design of material handling equipments such as hoist conveyor, elevators etc						
COURSE OUTCOMES (COs)						
CO1	Can design material handling equipments					
CO2	Can design drives of hoisting gears					
CO3	Can design conveyors					
CO4	Can design elevators					
CO5	Can design different brakes for material handling equipments.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I MATERIAL HANDLING EQUIPMENT

4

Types, selection and applications

UNIT – II DESIGN OF HOISTS

15

Hoisting, elements – wheeled and roller chains – hemp and wire ropes – factors to be considered in design of ropes. Pulleys, pulley system, sprockets and drums – load handling attachments – design of forged hooks and eye hooks – crane grabs – lifting magnets – grabbing attachments – design of arresting gear – brakes shoe, band and cone types.

UNIT – III DRIVES OF HOISTING GEAR

6

Hand and power drives – travelling gear – rail traveling mechanisms – cantilever and monorail cranes – slewing, jib and fluffing gear – cog wheel drive motor rating selection.

UNIT – IV CONVEYORS

10

Types – description – design and application of belt conveyors – apron conveyors and escalators – pneumatic, screw & vibratory conveyors.

UNIT – V ELEVATORS

10

Types – description – bucket elevators – arrangements – cage elevators – shaft ways guides counter weighty – hoisting machine – safety devices – forms lift trucks.

Total Periods: 45

References:

1. Rudenko N Material handling equipment, Elnvee Publishers 1981

2. Spivakovsy A.O. and Dyachkov V.K. Conveying machines, volume I and II, MIR Publishers , 1985.
3. Alexandrov M. Material Handling Equipment, MIR Publisher, 1981.
4. Bolizharol. A. Material handling handbook, The Ronald Press Company, 1958.

Course Code MMD003	Course Name: TOOL DESIGN				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES Understand the importance of tool design for productive manufacturing and basic procedure of tool design, drafting of tool drawing etc., Bring in the required properties of the tool material by proper selection and heat treatment appropriate to the cutting process adopted. Understand the concepts of tolerance and make use of gauges to measure the same. Understand the design concepts of Jigs & Fixtures Get proper knowledge in the latest area of tooling for CNC machines								
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							
CO4	Understand the design concepts of Jigs & Fixtures							
CO5	Get proper knowledge in the latest area of tooling for CNC 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	a	b	c	d	e		
2	CO1	L				H		
	CO2		H					
	CO3			M				
	CO4		L					
	CO5					M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				✓				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT – I

8

Mechanics of chip formation – chip control-chip breakers – cutting forces and measurements merchant's theory – specific cutting energy – shear angle – theory of lee and Shaffer – friction in cutting – measurements of cutting temperatures – influence of tool geometry on cutting forces.

UNIT – II

8

Tool materials – composition – selection and treatments – cutting fluids selection and types - tool wear determination – tool life – Taylors formula – feed, speed & depth of cut – life based on volume.

UNIT – III

Design of single point cutting tool – design of multipoint cutting tools – form tools – drills, milling cutters and broaches.

UNIT – IV

Design of simple, progressive compound dies – bending dies – bend allowances – bending pressure – metal flow in drawing – drawing force – single and double section draw dies – forging and dies.

UNIT – V

Design of blanking and piercing Dies – Die cutting operations – press tools power press types – cutting action in punch and die operation – die clearance – die construction centre of pressure – scrap strip layout – pilots – stripers and pressure pads – tooling for piercing.

Total Periods: 45

Reference:

1. Donaldson tool design 3rd edition, TMH, 1973.
2. Sen and Bhattacharya, principles of metal cutting CBS, 1995.
3. Basu, U- Fundamentals of tool engineering design oxford and IBH, 1990.
4. Colei B.C-tool design.
5. Nagpal GR-Tool engineering and design, khanna publication, 1999

Course Code MMD004	Course Name: DESIGN OF JIGS AND FIXTURES	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
1. Understand the importance of tool design for productive manufacturing and the basic procedure of tool design, drafting of tool drawing etc.,						
2. Bring in the required properties in the tool material by proper selection and heat treatment appropriate to the cutting process adopted.						
3. Understand the concepts of tolerance and make use of gauges to measure the same						
4. Understand the design concepts of Jigs & Fixtures						
5. Get proper knowledge in the latest area of tooling for CNC machines.						
COURSE OUTCOMES (COs)						
CO1	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					
CO4	Understand the design concepts of Jigs & Fixtures .					
CO5	: Get proper knowledge in the latest area of tooling for CNC 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	a	b	c	d	e

2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT - I

Location and clamping devices – principles – need – types of location devices – types of clamping devices – clamping forces – hydraulic and pneumatic clamping systems.

UNIT – II

Fixtures – design principles – types of fixtures – fixtures for machine tools – lathe, milling, boring, and broaching.

UNIT - III

Fixtures for grinding, assembly, shaping, welding and inspection – clamping & other forces – designing.

UNIT – IV

Jigs – objectives – design principles – types of drill jigs – chip control – drill bushing – advantages and limitations.

UNIT – V

Calculation of forces – design of drill jigs – leaf, box, plate – indexing and universal jigs.

Total periods: 45

References:

1. DONALDSON .C. Tool Design – Tata Mc Graw Hill Col Ltd, 1973.
2. KEMPSTER .Introduction of tool design and Jigs And Fixtures, ELBS, 1974.
3. Hiram .E. Grant – Jigs and Fixtures, TMH, 1971.
4. Korakow – fundamentals of jigs and fixtures, MIR publication, 1985.
5. Joshi .P.H. Jigs and fixtures TMH, 1990

Course Code MCD101	Course Name: INTEGRATED PRODUCTION DESIGN & DEVELOPMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES Understand the concept of integrated product and process development					

combined the product design process to create a new standard for providing. Gain the knowledge on the product design and development process						
COURSE OUTCOMES (COs)						
CO1		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	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5				H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Course Code MCD003	Course Name: DESIGN FOR MANUFACTURING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Mechanical Engineering							
To educate students a clear understanding of factors to be considered in designing parts and components with focus on manufacturabilityTo know the concept of design for manufacturing, assembly and environment.To know the computer application in design for manufacturing and assembly.								
COURSE OUTCOMES (COs)								
CO1	To make the students get acquainted with the design for manufacturing, assembly and environment							
CO2	Can do design alteration for preparing components based on casting process							
CO3	Can do design alteration for preparing components based on forging process							
CO4	Can do design alteration for preparing components based on welding process							
CO5	Can do design alteration for preparing components based on machining 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	L				S		
	CO2		H					
	CO3			M				
	CO4		L					
	CO5					M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT – I**9**

General design principle for manufacturability – process capability – surface finish – tolerances – Feature tolerance – cumulative effect of tolerances – surfait. Normal & Fruncated normal laws – Geometric tolerances.

UNIT – II**9**

Fits – universal interchangeability – selective Assembly – control of axial play – second stage machining – laminated – Automated assemblies – Grouped datum systems Deciding the number of groups, types.

UNIT – III

9

True position theory – virtual size concept – true position tolerancing – fixed fasteners – floating fasteners – zero true position tolerances – functional gauging – paper layout gauging.

UNIT – IV

9

Form design of castings – Redesigning-parting line consideration – minimizing core requirements – economic design of castings – form design of weldments. – Welding symbols – Redesigning cast members using weldments – economic weldments.

UNIT – V

9

Design for assembly – design for inspection – design for machining – Redimensioning based on manufacturing datums – design reduce value addition – parts cut to length – machined round holes – blind & through holes – design consideration for various machining operations.

Total Periods: 45

Reference:

1. M.F.SPOTTS - “Dimensioning & tolerating for quantity production”- prentice Hall
2. HARRY PECK - “Designing for manufacture “– Pitman publications , 1973.
3. JAMES G. BRALLA – “Hand Book of Product design for manufacturing.”

Course Code MCD004	Course Name: PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To impart knowledge regarding trends in operation management, layout planning,Scheduling system						
COURSE OUTCOMES (COs)						
CO1	an forecast trends in operation management.					
CO2	Can do layout planning.					
CO3	Can do project management.					
CO4	Capable of inventory control					
CO5	Capable doing of master scheduling etc.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5				M	

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

UNIT –I 9

Introduction – trends in operation management – careers in production management – planning productivity and quality – forecasting.

UNIT – II 9

Layout planning – types – developing the layouts – manufacturing cellular layout – improved performances – job design – production and operation standards – work measurement.

UNIT – III 9

Project management – project planning project scheduling models – PERT – CPM – selecting a project management software package

UNIT – IV 9

Scheduling systems – Aggregate planning process – master scheduling – rough cut capacity planning – implementing Aggregate plans and master schedules.

UNIT – V 9

Inventory control fundamentals – control application – material requirements planning – manufacturing resource planning – quality analysis and control

Total periods: 45

References:

1. Everff e Adam Jr. Ronald.J Ebert “production and operation management “PHI fifth edition 1992
2. Chary S.N “theory and problems in production and operation management “TMH 1997.
3. Panneerselvam.R.”Productions and operations management “PHI, 1999
4. Buffa.E. “Modern production / operational management “John Wiley & Sons, 7th edition
5. Saravanavel .P. and Sumathi.S “production and materials management “Margham publications, Chennai-2000.

Course Code MCD005	Course Name: MECHATRONICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To enable the students to understand the fundamental concepts of Semi-Conductors, Transistors, Rectifiers, Digital Electronics .					
COURSE OUTCOMES (COs)					
CO1	Understand the fundamentals of mechatronic systems in a synergistic framework				

CO2	Design and develop intelligent engineered products and processes to solve challenging technological problems.					
CO3	Design and simulate mechatronic systems using microcontrollers and programmable logic controllers					
CO4	Develop innovative approaches and an entrepreneurial mind set to problem solving					
CO5	Can develop data handling and data acquisition system etc.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				S
	CO2		H			
	CO3			M		
	CO4	L			M	
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

Introduction – systems – Measurement systems – Control system Microprocessor – Based controllers & problems.

UNIT – II

Sensors and transducers – performance – terminology – Displacement – position and proximity – velocity and motion – force – fluid pressure liquid flow – liquid level – temperature – light sensors – selection of sensors.

UNIT – III

Signal conditioning – The operational amplifier protection – filtering – wheat stone bridge – Digital signals – multiplexes – data acquisition – digital signal processing – pulse – modulation.

UNIT – IV

Data presentation system – displays – data presentation elements – magnetic recording – Displays – data acquisition systems – Measurement system – testing and calibration.

UNIT – V

Pneumatic & hydraulic system – Mechanical actuation systems.

Reference:

1. W.Bolton, Mechatronics Electronics control system in Mechanical & Electrical Engg. Addison 1999.

2. Michael – B. Histland, David. G. Aliatoce – Introduction to Mechatronics and measurement system – McGraw Hill International Edition.

Course Code MCD201	Course Name: OPTIMIZATION IN MECHANICAL ENGINEERING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES To impart knowledge regarding various parameters of optimization.								
COURSE OUTCOMES (COs)								
CO1	Gain knowledge of fundamentals and classification of various optimization techniques.							
CO2	Understand the concepts of non-linear programming and various search methods.							
CO3	Provide knowledge on geometric programming.							
CO4	Understand the knowledge of optimization in designing of various machine elements.							
CO5	Provide knowledge on geometric 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		
2	CO1	L				S		
	CO2		H					
	CO3			M				
	CO4	L						
	CO5					M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
				√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

Engineering application of optimization, statement of an optimization problem – design vector , design constraints , constraint surface – objective functions – objective function surfaces , classification of optimization problems

UNIT – II NONLINEAR PROGRAMMING

12

One dimensional minimization methods – elimination methods – unrestricted search , Exhaustive search , dichotomous search , interval halving unrestricted search , Exhaustive search , dichotomous search interval halving method , fibonacci method , golden section method interpolation methods – quadratic interpolation method , cubic interpolation method.

UNIT – III NON LINEAR PROGRAMMING ON CONSTRAINED OPTIMIZATION TECHNIQUES

12

Random search method – Random jumping method. Walk method, Walk method With distance Grid search method Indirect search method steepest descent (Cauchy) method Newton's method Quasi – Newton method.

UNIT – IV OPTIMIZATION IN THE DESIGN PARAMETERS

12

Signal response optimization Taguchi method , Genetic Algorithm & Simulated Annealing Techniques Neural Network based optimization.

Total Periods: 45

Reference:

1. S.S.Rao, Engg, Optimization Theory & Practice 'Third Edition, New age Publication, 1996.
2. Katyanmog Deb, Optimization for Engg.Design Algorithms & Examples, PHI ,1995.

Course Code ED7003	Course Name: COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.Implementation of Classical Laminate Theory (CLT) to study and analysis for residualStresses in an isotropic layered structure such as electronic chips					
COURSE OUTCOMES (COs)					
CO1	1. To understand the fundamentals of composite material strength and its mechanical behavior Stresses in an isotropic layered structure such as electronic chips.				
CO2	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.				
CO3	Thermo-mechanical behavior and study of residual stresses in Laminates during				

		processing				
CO4	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips.					
CO5	At the end of the course the students will be in position to understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropiclayered structures (example electronic chips) etc and its manufacturing methodologies.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

OBJECTIVES:

1. To understand the fundamentals of composite material strength and its mechanical behavior
2. Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
4. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips.

OUTCOME:

1. At the end of the course the students will be in position to understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropiclayered structures (example electronic chips) etc and its manufacturing methodologies.

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 10

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers,inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures- Characteristics of fiber-Reinforcedcomposites, Manufacturing fiber and composites,

UNIT II MANUFACTURING OF COMPOSITES 10

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding,

Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation-interfaces

UNIT III INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS 12

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES 8

Introduction - Maximum Stress and Strain Criteria. Von-Mises Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT V THERMAL ANALYSIS 5

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

TOTAL: 45 PERIODS

REFERENCES

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber – "Reinforced Composites: Materials, Manufacturing and Design", Maneeel Dekker Inc, 1993.
5. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
6. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
7. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.
8. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)
9. Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint, 2009

Course	Course Name: ROBOTICS	L	T	P	C

Code MAE002	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES To study robot organizations.To study basics of artificial intelligence. To st about robotic vision systems.								
COURSE OUTCOMES (COs)								
CO1	Define basic concepts in modeling and simulation (M&S)							
CO2	Classify various simulation models and give practical examples for each category							
CO3	Construct a model for a given set of data and motivate its validity							
CO4	Generate and test random number varieties and apply them to develop simulation models.							
CO5	Analyze output data produced by a model and test validity of the model.							
Mapping of Course Outcomes with 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	L				S		
	CO2		H					
	CO3			M				
	CO4	L						
	CO5							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
					√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT-I ROBOT ORGANIZATION

9

Coordinate transformation, kinematics and inverse kinematics, Trajectory planning and remote manipulation

UNIT-II ROBOT HARDWARE

9

Robot sensors, proximity sensors, Range sensors, visual sensors, Ausitory sensors, Robot manipulators, Manipulator dynamics , Manipulator control, acts, end efforts, Robot grippers.

UNIT III ROBOT AND ARTIFICIAL INTELLIGENCE

9

Principles of AI , Basics of learning, planning movement, Basics of knowledge presentations, Robot programming languages.

UNIT IV ROBOTIC VISION SYSTEMS

9

Principles of edge detection, Determining optical flow and shape, Image presentation, pattern recognition, Model directed scene analysis

UNIT V ROBOT CONTROL AND APPLICATION

9

Robot control using voice and infrared, overview of robot applications, prosthetic devices,

Robots in material handling, processing assembly and storage.

Total Periods: 45

Text Books:

1. Koren, "Robotics for Engineers", MC Graw Hill International company, Tokyo, 1995
2. Vokopravotic, "Introduction to Robotics", Springer, 1998
3. Rathmill K, "Robot Technology and Application", Springer, 1985

Course Code MAE002	Course Name: SYSTEM MODELLING AND SIMULATION	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
COURSE OUTCOMES (COs)						
CO1	Classify various simulation models and give practical examples for each category					
CO2	Construct a model for a given set of data and motivate its validity					
CO3	Generate and test random number varieties and apply them to develop simulation models.					
CO4	Analyze output data produced by a model and test validity of the model.					
CO5	Explain the concept of output analysis of single model.					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H	H	M	H
	CO2		M	H	H	H
	CO3	M		M	M	M
	CO4	M	H	H	H	H
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT –I INTRODUCTION TO SIMULATION

12

Advantages and disadvantages of simulation, areas of application, System environment, Components of a system. Discrete and continuous systems, model of a system. Types of models. Steps in a simulation study, simulation examples: simulation of queuing systems, simulation of inventory systems. Discrete event simulation, general principles and computer simulation languages. FORTRAN, SIMSCRIPT, GPSS.

UNIT-II STATISTICAL MODELS IN SIMULATION**12**

Review of terminology and concepts. Useful statistical models, discrete distributions, continuous distributions. Poisson process, Empirical distributions, Queuing models: Characteristics of queuing systems, queuing notations. Transient and steady state behaviour of queues, steady-state behaviour of infinite population, Markovan models, Steady state behaviour of finite population models.

UNIT-III INVENTORY SYSTEMS**12**

Measures of effectiveness, inventory policies, deterministic systems probabilistic systems, simulation in inventory analysis. Random number generation. Properties of random numbers. Generation of pseudo-random numbers. Tests for random numbers. Random variate generation: Inverse transform technique, Direct transform for the normal distribution, convolution method. Acceptance-Rejection technique.

UNIT-IV INPUT DATA ANALYSIS

Data Collection, Identifying the distribution, Parameter estimation, Goodness-of-fit tests, Verification and validation of simulation models: Models Building, calibration and validation of models.

UNIT-V OUTPUT ANALYSIS FOR A SINGLE MODEL

Stochastic nature of 0/1 data, types of simulations with respect to O/P analysis, Measures of performance and their estimation, O/P analysis for terminating simulations, O/P analysis for steady-state simulations.

TOTAL NO OF PERIODS: 60**TEXT BOOKS**

- 1) Jerry Banks, Carson. J.S., and Nelson B.L., “Discrete Event System Simulation”, Prentice Hall of India, New Delhi, 2006.
- 2) Karian, Z. A., Dudewicz, E. J. (112121), “Modern statistical systems, and GPSS simulation: the first course”, W. H. Freeman and Company, New York, 2005.

REFERENCES

1. System Modelling and Simulation, V.P.Singh, New Age International Publishers, 2009.
2. <https://Shamsulsarip.Files.Wordpress.Com/2015/07/System-Modelling-And-Simulation.Pdf>

3 0 0 3

Course Code MMD205	Course Name: RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To Get adequate knowledge about research concepts. To desc mathematical modeling and simulation. To understand experimental modeling. To knowledge about the interpretation of result.					
COURSE OUTCOMES (COs)					
CO1	To describe research concepts.				
CO2	To Get adequate knowledge about mathematical modeling				
CO3	To describe experimental modeling				
CO4	To understand analysis of results.				
CO5	To know about report writing				
Mapping of Course Outcomes with 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	L				H
	CO2	M	H			
	CO3			M		H
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3. EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4. ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5. REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.

- Schank Fr., "Theories of Engineering Experiments", Tata Mc Graw Hill Publication.

REFERENCE BOOKS

- Douglas Montgomery, "Design of Experiments", Statistical Consulting Services, 1990.
- Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.
- Cochran and Cocks, „Experimental Design“, John Willy & Sons.
- John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
- Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication.
- S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996

Course Code ED7003	Course Name: Advanced Material Science and Failure Analysis In Mechanical Design				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite:							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips								
COURSE OUTCOMES (COs)								
CO1	1. To understand the fundamentals of composite material strength and its mechanical behavior Stresses in an isotropic layered structure such as electronic chips.							
CO2	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.							
CO3	Thermo-mechanical behavior and study of residual stresses in Laminates during processing							
CO4	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips.							
CO5	At the end of the course the students will be in position to understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropic layered structures (example electronic chips) etc and its manufacturing methodologies.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	L				S		
	CO2		S					
	CO3			M				
	CO4	L						
	CO5							

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

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.

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.

Course Code MMD005	Course Name: ENGINEERING FRACTURE MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions. To impart knowledge on mechanics of cracked components of different modes by which these components fail under fatigue load conditions.					
COURSE OUTCOMES (COs)					
CO1	It helps the engineers to get familiarized with the design of components that contain crack under static load condition				

CO2		Identify and formulate the stress intensity factor ((K) for typical crack configurations				
CO3		Define the near field equations to determine the stress-strain and load-displacement fields around a crack tip for linear elastic cases.				
CO4		Identify and formulate the strain energy release rate (G).Identify and formulate J integral and the stress and strain fields around a crack tip for non linear				
CO5		Employ the standard and non standard fracture mechanics tests to determine the fractureToughness 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	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I ELEMENTS OF SOLID MECHANICS

9

The geometry of stress and strain, elastic deformation, plastic and elastic-plastic deformation - limit Analysis – Air's function – field equation for stress intensity factor.

UNIT II STATIONARY CRACK UNDER STATIC LOADING

9

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's Approximation - plastic zone size – Dugdale model – determination of J integral and its relation to crack opening displacement.

UNIT III ENERGY BALANCE AND CRACK GROWTH

9

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

UNIT IV FATIGUE CRACK GROWTH CURVE

9

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

UNIT V APPLICATIONS OF FRACTURE MECHANICS

9

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

TOTAL: 45 PERIODS

REFERENCES:

1. David Broek, "Elementary Engineering Fracture Mechanics", Elsevier and Noordhoff International Publisher, 1978.
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
4. John M. Barson and Stanley T. Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1977
5. Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 1st Indian Reprint, 2012

CURRICULUM AND SYLLABUS (R 2016)

CHOICE BASED CREDIT SYSTEM

M.TECH – CAD (FULL TIME) I- IV SEMESTERS

SEMESTER – I							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MMA105	PM	Applied Mathematics	3	2	0	4
2	MMD101	PC	Mechanical Vibrations	3	0	0	3
3	MMD102	PC	Advanced Strength of Materials	3	0	0	3
4	MCD101	PC	Integrated Product Design & Development	3	0	0	3
5	MCD102	PC	Computer Graphics	3	0	0	3
6	MMD104	PC	Finite Element Analysis	3	0	0	3
7	MCD1L1	PC	CAD Laboratory	0	0	4	2

TOTAL CONTACT HOURS-22

TOTAL CREDIT: 21

SEMESTER – II							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MCD201	PC	Optimization in Mechanical Engg.	3	0	0	3
2	MCD202	PC	Computer Aided Manufacturing	3	0	0	3
3	MCD203	PC	Computer applications in design	3	0	0	3
4	MCD204	PC	Computer Aided Machine element Design	3	0	0	3
5	MCD2E1	PE	Professional Elective – I	3	0	0	3
6	MCD2E2	PE	Professional Elective – II	3	0	0	3
7	MMD2L1	PC	Design and Analysis Lab	0	0	4	2

TOTAL CONTACT HOURS-22

TOTAL CREDIT: 20

SEMESTER – III							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MCD3E3	PE	Professional Elective – III	3	0	0	3
2	MCD3E4	PE	Professional Elective - IV	3	0	0	3
3	MCD3E4	OE	Open Elective	3	0	0	3
4	MCD3P1	PR	Project Work Phase I	0	0	12	6

TOTAL CONTACT HOURS-21

TOTAL CREDIT: 15

SEMESTER – IV							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MCD4P2	PR	Project Work Phase II	0	0	24	12

TOTAL CONTACT HOURS-24

TOTAL CREDIT: 12

TOTAL PROGRAMME CREDITS: 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 Mathematics (PM)	4	-	-	-	4	5.88%
2	Professional Core (PC)	17	11	-	-	28	41.476 %
3	Professional Electives (PE)	-	9	6	-	15	22.051%
4	Open Electives (OE)	-	-	3	-	3	4.410%
5	Project Work, Seminar, Internship, etc. (PR)	-	-	6	12	18	26.42%
	Total Credit	21	20	15	12	68	100%
	Total Contact Hour	22	22	21	24	89	

LIST OF ELECTIVES

Professional Elective –I

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MCD001	Rapid Prototyping	3	0	0	3
2	MMD 001	Vibration Control And Condition Monitoring	3	0	0	3
3	MMD 201	Advanced Design Of Transmission System	3	0	0	3
4	MME203	Computational Fluid Dynamics.	3	0	0	3
5	MMD 205	Machine Tool Design	3	0	0	3

Professional Elective –II

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MCD 002	Concurrent Engineering	3	0	0	3
2	MMD 003	Tool Design	3	0	0	3
3	MMD202	Tribology	3	0	0	3
4	MMD203	Design of Pressure Vessels and Piping	3	0	0	3
5	MMD206	Design Of Hydraulic And Pneumatic System	3	0	0	3

Professional Elective –III

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MCD 003	Design For Manufacturing	3	0	0	3
2	MCD 004	Production And Operation Management	3	0	0	3
3	MMD 004	Design of jigs and fixtures	3	0	0	3
4	MMD 103	Design Of Mechanism-I	3	0	0	3

Professional Elective –IV

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MMD105	Engineering Design	3	0	0	3
2	MMD004	Design Of Material Handling Equipments	3	0	0	3
3	MMD006	Composite Materials And Mechanics	3	0	0	3
4	MMD 005	Engineering Fracture Mechanics	3	0	0	3

Open Elective

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MAE002	Robotics	3	0	0	3
2	MCS157	System Modeling And Simulation	3	0	0	3
3	PCD 005	Mechatronics	3	0	0	3
4		Research Methodology				
5	MMD 007	Advanced Material Science ,Failure Analysis And Design	3	0	0	3

Course Code MMA105	Course Name:APPLIED MATHEMATICS	L	T	P	C
	Total Contact Hours:45	3	0	0	4

		Prerequisite: Engineering mathematics				
		Course Designed by :				
OBJECTIVES The main objectives of the course are to enhance the knowledge of various meth in finding the Eigen values and Eigen vectors of matrix, and also to evaluate differentiation complex functions with a greater accuracy to formulate Problems in engineering and solve th analytically and numerically						
COURSE OUTCOMES (COs)						
CO1	Compute Eigen vectors for given matrix by different methods					
CO2	Solve vibrational problem by different methods.					
CO3	Convert boundary value problems into integral equations and find solutions.					
CO4	Apply probability concepts to arrive engineering solutions					
CO5	Understand concepts of applied mathematics					
Mapping of Course Outcomes with 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	L				
	CO2		H			
	CO3			M		
	CO4			L		
	CO5					H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I : MATRIX THEORY

9

Eigenvalues using QR transformation – Generalized Eigenvectors – canonical forms – singular value decomposition and application – matrix norms and induced norms – Pseudoinverse – Least approximations.

UNIT– II: CALCULUS OF VARIATIONS**9**

Variation and its properties–Euler’s Equation–Functional dependent on first and higher order derivatives –Functional dependent on functions of several independent variables – Constraints in the form of a functional isoperimetric problems–Direct methods– Ritz Kantorovich methods– Boundary value problems.

UNIT– III : TRANSFORM METHOD**9**

Laplace transform methods for one dimensional wave equation–displacement in a line string– Longitudinal vibrations of elastic bar –Fourier transform methods for one dimensional heat conduction problems in infinite and semi infinite rod.

UNIT IV: PROBABILITY**9**

Probability concepts–Random Variables– Estimation - Hypothesis Testing - Analysis of Variance-Discrete and continuous distributions— Oneway, two way classifications.

UNIT V : CURVE FITTING**9**

Correlations-Partial, Multiple, Rank – Regression–Multiple regressions- Trend analysis– Polynomial fitting- Estimation – Point and interval Estimates – Probability – Distributions – Estimation – Hypothesis Testing – Anova Classification – Correlation and Regression – Trend Analysis.

Total Periods:45**TEXTBOOKS:**

1. Sankara Rao K. “Introduction to Partial Differential Equation” Prentice Hall of India, New Delhi 1995.
2. Curtis F. Gerald. “Applied Numerical Analysis” 7th Edn. Pearson Education, Chennai-600113. 2007.
3. Gupta, A.S. “Calculus of Variations with Applications”, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

REFERENCE BOOKS:

1. Douglas C. Montgomery and George C. Runger. “Applied Statistics and Probability for Engineers” 5th Edn. Wiley India Pvt Ltd., New Delhi. 2010.
2. Freund J.E. and Miller J.R., “Probability and Statistics for Engineers” 5th Edn. Prentice Hall of India, New Delhi. 1994.
3. Dennis G. Zill and Warren S. Wright. “Advanced Engineering Mathematics”. 3rd Edn. Jones & Bartlett Publishers, UK. 1992.

Course Code	Course Name: MECHANICAL VIBRATIONS	L	T	P	C

MMD101	Total Contact Hours: 45				3	0	0	3
	Prerequisite: GENERAL MATHEMATICS							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES The course should enable the students to: 1. Understand the sources of vibration and noise in automobiles and make design modifications 2. Learn to reduce the vibration and noise and improve the life of the components								
COURSE OUTCOMES (COs)								
CO1	Understand the causes and effects of vibration in mechanical systems .							
CO2	Understand the Classification.							
CO3	Develop schematic models for physical systems and formulate governing equations of motion.							
CO4	Understand the role of damping, stiffness and inertia in mechanical systems							
CO5	Analyze rotating and reciprocating systems and design machine supporting structures, vibration isolators and absorbers							
Mapping of Course Outcomes with 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	L				H		
	CO2		H					
	CO3			M				
	CO4		L		M			
	CO5	M				L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I

ONE DEGREE OF FREEDOM SYSTEMS

Vibration principle-Equilibrium & Energy methods- free vibrations – Viscous & coulomb damping – Forced vibration – Base excitation – Transmissibility – Resonance – Characteristics.

UNIT II **9**

TWO DEGREE TO FREEDOM SYSTEMS

Two degrees of freedom – Matrix form –Undamped free vibration- Principal modes – Co-ordinate coupling – Principal Co-ordinates – Torsional vibrations – Hoizer method – Work & Energy approach.

UNIT III **9**

TRANSIENT VIBRATIONS

Transient vibration – Time dependency – Laplace transforms – Step inputs - Pulse inputs – Impulse function – Duhamel’s integral – Phase plane method – Shock spectrum.

UNIT IV **9**

MULTI DEGREE OF FREEDOM SYSTEMS

Multi degree of freedom – Equations of motions – Solution – Orthogonality of normal modes – Continuous Systems – Free & forced vibrations – Vibration analysis by FEW.

UNIT V **9**

VIBRATION MEASURING SYSTEMS

Vibration instruments – Vibration absorber – Elastically supported dampers –Seismic instruments – Vibrometres – Pickups – Accelerometers – Mounting instruments – Amplitude & Phase distortions .

Total Periods: 45

TEXTBOOKS :

1.G.K.Grover-Mechanical vibrations Namchand& Bros. 1996.

- 2.V.P.Singh-Mechanical Vibrations-Dhanpat Rai & Co.2000.
3.S.S. Rao Mechanical Vibrations, Pearson Education 1995.

REFERENCES:

1. W.T. Thomson-Theory of Vibration-Uniwin Hyman Ltd/CBS Publishers, 1990.
2.Francis. S. Tse, Iran, E.Morse, Rolland. T.Hinkle-Mechanical Vibrations –CBS Publishers,1983.
3.S.P.Timoshenko-Vibration problems in Engineering-CBS Publishers

Course Code MMD 102	Course Name: ADVANCED STRENGTH OF MATERIALS		L	T	P	C
	Total Contact Hours:		3	0	0	3
	Prerequisite: MECHANICS OF SOLIDS					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES To understand the strain/displacement and Hooke’s law relationships • To solve torsion problems in bars and thin walled members • To solve for stresses and deflections of beams under unsymmetrical loading • To locate the shear center of thin wall beams						
COURSE OUTCOMES (COs)						
CO1		Understand and analyze stresses and strains at a point.				
CO2		Determine stress-strain relations for linearly elastic members using normal stress, shear stress				
CO3		Learn distortion energy theories.				
CO4		Model and analyze mechanical structures using energy methods.				
CO5		Design straight beams, curved and asymmetrical bending of beams.				
Mapping of Course Outcomes with 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	L				H
	CO2		H			
	CO3			M		
	CO4		L		M	
	CO5	H				

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

UNIT I

UNSYMMETRIC BENDING AND SHEAR CENTER

Unsymmetric bending of straight beams – Generalized theory – Bending stresses – deflection- Transverse shear stress-Shear centers of thin walled sections.

UNIT II

9

CURVED FLEXURAL MEMBERS

Circumferential stress-Radial stress and Shear stress – closed rings subjected to concentrate loads-crane hooks – Chain links

UNIT III

9

TORSION AND CONTACT STRESSES

Saint Venant theory – Membrane analogy – thin walled open sections – Thin walled multicell tubes - Warping of thin walled open and closed cross sections – Contact Stresses – Spheres and Cylinders.

UNIT IV

9

STRESSES DUE TO ROTATION, FLAT PLATES

Spinning disks – Flywheels – Flat disks – variable thickness – Uniform strength – Allowable speeds . Symmetrically loaded circular plate. Circular plate freely supported at its circumference, circular plate with central hole, Freely supported at its circumference, Circular plate clamped at its circumference, Bending of rectangular plates.

UNIT V

9

THEORY OF ELASTICITY

General Equations of Elasticity- Cartesian and Polar – Equilibrium and stresses – Compatibility of Strains – Boundary conditions – Stress tensors – Saint Venant’s Principle – Plane stress – Plane strain – Airy’s stress function.

Total periods: 45

TEXTBOOKS :

1. Budynas –advanced Strength and Applied Stress Analysis. Tata McGraw Hill, 1999.
2. . B.C. Punimia –Strength of Materials and Mechanics of Structures, 1996.

REFERENCES :

1. R.D. Cook, W.C. Young –Advanced Mechanics of Materials –Prentice Hall, 1999.
2. S.P. Timoshenko, J.N. Goodier –Theory of elasticity – McGraw Hill, 1987
3. S.P. Timoshenko – Strength of Materials – TMH, 1986.

Course Code MCD101	Course Name: INTEGRATED PRODUCT DESIGN & DEVELOPMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: MANUFACTURING TECHNOLOGY I & II				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES 1. Understand the concept of integrated product and process development that combined the product design process to create a new standard for providing. 2. Gain the knowledge on the product design and development process.					
COURSE OUTCOMES (COs)					
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	L				
	CO2		H			
	CO3			M		
	CO4	L				
	CO5				H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I FUNDAMENTALS OF DESIGN

9

Product development – Marketing Design & Production-Design process – Morphology of design – Asimov's Model – Problem statement – Product design specifications – Concept selection techniques.

UNIT II

9

PRODUCT STRATEGIES

Product strategies – Product analysis – Standardization, Simplification & Specialization – Creativity – Aesthetics – Ergonomics – functional Design – Hierarchy of Needs – Need analysis.

UNIT III**9****ECONOMIC ANALYSIS**

Customers & Competitors – Product value – Economic analysis – Qualitative & Quantitative Analysis – Profit considerations – Break even analysis – Profit volume charts.

UNIT IV**9****PRODUCT ARCHITECTURE**

Product Architecture – Modularity – Product change – Product variety – Component standardization – Performance – Manufacturability – Establishing the architecture – Variety & Supply chain – Platform planning.

UNIT V**9****INDUSTRIAL PRACTICES**

Conventional practices – recent trends – Technology & User driven products – Advertisements – Patents – Case studies.

Total Periods: 45**TEXTBOOK:**

- 1.G.E.Dieter –engineering Design – McGraw Hill, 1991
- 2.Chitale, Guptha – Product Design & Manufacturing – Prentice Hall 1997.

References:

- 1.Karl. T.Ulrich, Steven D. Eppinger –ProductDesign &Development -McGraw Hill 2000

Course Code MMD104	Course Name: FINITE ELEMENT ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: MATHEMATICS				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES 1. To present the Finite element method (FEM) as a numerical method for					

engineering analysis of continua and structures						
2. To present Finite element formulation using variational and weighted residual approaches						
3. To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress plane strain problems and 3-D solids, for thermal and dynamics problems						
COURSE OUTCOMES (COs)						
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
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L			M	
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

BASIC CONCEPTS

Field problems – elementary treatments – Elements & types – Mathematical modeling –Steady state problems – Propagation problems – Eigen value problems – Differential formulation – Variational methods-Weighted residual methods – Convergence criteria – Error estimation.

UNIT II

9

PROCEDURES & INTERPOLATIONS

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 distributions, Heat transfer.

UNIT III

9

ELASTICITY PROBLEMS

Elasticity concepts – Plane stress & strain – Element stiffness matrix – Strain – Displacement relations – Material property matrix – Constitutive relationship – Nodal forces using equilibrium – Euler – Bernoulli beam elements – Trusses & Frames

UNIT IV

9

ISOPARAMETRIC FORMULATION

Node numbering – Transformation – Natural co-ordinates – Approximation of geometry – Isoparametric formulation – Gauss quadrature –Choice of quadrature rule –Stress calculations – Gauss point.

UNIT V

9

FE IN STRUCTURAL DYNAMICS

Finite Elements in Structural Dynamics and Vibrations Dynamic equations- stiffness, mass and damping matrices- consistent and diagonal .mass matrices- Extraction of natural frequencies and modes- Reduction of number of degrees of freedom - modal methods - component mode synthesis- harmonic analysis response history- explicit and implicit direct integration- stability and accuracy

Total Periods :45

TEXTBOOKS:

1. K.Senthil- An Introductionto Finite element Analysis- Lakshmi Publication

REFERENCES:

- 1.J.N. Reddy-An Introduction to Finite Element Methods – McGraw Hill 1993.
2. K.J. Bathe – Finite Element Procedure-Prentice Hall of India 1997
- 3.O.C. Zienkiewicz-The Finite Element Methods –McGraw Hill 1989
4. T.R. Chandraputla. A.D. Bele-gundu- Introduction to Finite Elements in Engineering – Prentice Hall of India 1997.

Course Code MCD102	Course Name: COMPUTER GRAPHICS			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: MANUFACTURING TECHNOLOGY						
	Course Designed by : Dept. of Mechanical Engineering						
OBJECTIVES To Impart Knowledge Regarding Geometric Transformation, Geometric Modeling etc.							
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	M	L	-	-	-	
	CO2	H	M	-	-	-	
	CO3	H	M	-	L	-	
	CO4	H	M	M	H	-	
	CO5	H	H	H	H	-	

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

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 GEOMETRIC TRANSFORMATION 9

Output primitives-Points & Lines-DDA & Bresenham's algorithms-Circles –Mid point algorithms-Geometric transformations-scaling-Translation-rotation-Shearing-Reflection-concatenation.

UNIT III GEOMETRIC MODELING 9

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 SOLID MODEL REPRESENTATION 9

Solid models-Representations-Boundary representation-Constructive Solid Geometry-Analytical solid modeling-Modeling packages.

UNIT V DATABASE AND DOCUMENTATION 9

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.

Total Periods:45

TEXTBOOK:

1. M.PaulineBaker,DonaldHrarn-Computer Graphics-Prentice Hall of India 1993.

REFERENCES:

2. Ibrahim Zeid-CAD CAM Theory & Practice-McGraw Hill 1998

Course Code MCD1L1	Course Name: CAD LABORATORY-1	L	T	P	C
	Total Contact Hours: 60	0	0	4	2
	Prerequisite: CAD LABORATORY (B-TECH)				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES For giving hand on experience of using modeling software’s like AUTO CAD,Cre0(Pro-E) etc. and to develop for simple programs.					
COURSE OUTCOMES (COs)					

CO1	Develop Auto LISP programs for drawing machine elements					
CO2	Develop codes for analytical and synthetic curves					
CO3	Draw machine elements in sketches					
CO4	Drawing the assembly models for machine elements such as Knuckle Joint, Universal Joint, Screw Jack, and plumber block etc					
CO5	Validate DXF, IGES and STEP formats for exchange of CAD files					
Mapping of Course Outcomes with 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	L	M	H	
	CO2	H	M	H	H	L
	CO3	H	M	H	H	
	CO4	H	M	H	H	
	CO5	H	L	H	H	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. Creation of working drawings of components and preparation of assembly models of Knuckle joint, Universal joint, screw jack, Plummer Block, Machine vice, Lathe chuck, Connecting rod, piston assembly etc., by using the following techniques.

a. Sketching

b. Part modeling

c. Surface modeling

d. Assembly

2. Generation of solid models using Constructive Solid Geometry(CSG) and Boundary representation (B-rep)

3. Draw the Shear force and Bending moment diagrams for the following beams using ANSYS packages.

a. Simply supported beam (point load & uniformly distributed load)

b. Cantilever beam (point load & uniformly distributed load)

4. Determine the natural frequency using FEA

5. Two-dimensional problems in static & dynamic analysis, Thermal analysis .

6. Working with IGES files and importing solid models from IGES files

7. Exercises in database management , familiarization with multiple file operations and preparation of various reports with respect to CIM.

Course Code MCD201	Course Name:OPTIMIZATION IN MECHANICAL ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: MATHEMATICS				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To impart knowledge regarding various parameters of optimization.					
COURSE OUTCOMES (COs)					
CO1	To understand how to optimize functions.				

CO2		Gain knowledge of fundamentals and classification of various optimization techniques.				
CO3		Understand the concepts of non-linear programming and various search methods.				
CO4		Provide knowledge on geometric programming.				
CO5		Understand the knowledge of optimization in designing of various machine 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	M				
	CO2	H	M		M	M
	CO3	H				
	CO4	H	H		H	
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

9

INTRODUCTION

Engineering application of optimization. Statement of an optimization Problem-Design Vector, Design constraints, constraint surface-Objective functions – Objective function Surfaces, Classification of optimization Problems.

UNIT II

9

NON LINEAR PROGRAMMING

One dimensional minimization Methods – elimination methods – Unrestricted search – Exhaustive Search- Dichotomous search-Interval halving methods-fibonacci method-golden section method-Interpolation methods-quadratic interpolation method, cubic interpolation method.

UNIT III

9

NON LINEAR PROGRAMMING ON CONSTRAINED OPTIMIZATION TECHNIQUES

Random search method-Random jumping method. walk method, walk method with distance, Grid search method, Indirect search method, Steepest descent (Cauchy) method, conjugate method, Newton's method. Quasi-Newton method.

UNIT IV

9

OPTIMIZATION IN THE DESIGN PARAMETERS

Single response optimization using Taguchi method, Genetic algorithm & simulated Annealing Techniques, Neural Network Based optimization.

Total Period : 45

TEXTBOOK:

1.S.S. Rao, Engg Optimization Theory & Practice, Third Edition, New Age Publication, 1996.

REFERENCE :

2. Kalyanmoy Deb, Optimization for Engg. Design Algorithms & Examples, PHI. 1995.

Course Code MCD202	Course Name: COMPUTER AIDED MANUFACTURING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: MANUFACTURING TECHNOLOGY				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES - To understand the management of design of product & processes, facility location & layout, capacity & resource & planning, and the modern trends in operations management - To understand the construction, working and different controls of Computer Numerical Control machines, basics of manual CNC programming and also of Programmable Logic Controllers					
COURSE OUTCOMES (COs)					

CO1	Understand the effect of manufacturing automation strategies and derive production metrics					
CO2	Analyze automated flow lines and assembly systems, and balance the line					
CO3	Design automated material handling and storage systems for a typical production system.					
CO4	Design a manufacturing cell and cellular manufacturing system					
CO5	Develop CAPP systems for rotational and prismatic parts					
Mapping of Course Outcomes with 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	M				
	CO2	H	M		M	M
	CO3	H				
	CO4	H	H		H	
	CO5	M	H		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

AUTOMATION AND NUMERICAL CONTROL

Types of production – Automation strategies-Numerical control systems –NC Part programming – Manual Part programming – Computer assisted Part programming-Part programming language-APT language.

UNIT II

10

CNC AND DNC

Computer Numerical Control – Principles of Operation – Features – Developments – After DNC – Direct Numerical Control – Features – Programmable Logic controllers – Communication networks – In process gauging – Configuration of CNC systems.

UNIT III **9**

INDUSTRIAL ROBOTICS

Robots –definition – Basic terminologies – End effectors, sensors used in robots – Robot control systems – Programming of industrial robots – methods – Robot programming languages.

UNIT IV **9**

GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS

Part families –classification and coding –Production Flow analysis – Machine cell Design –FMS workstations – analysis methods – Automated material handling - Types – Automated storage and retrieval systems.

UNIT V **8**

MANUFACTURING PLANNING SYSTEMS AND PROCESS CONTROL

Role of computers in Process Planning –CAPP – Computer integrated production planning system-MRP – Computer process interface-Process monitoring –Supervisory computer control specified as Materials requirement planning – Monitoring using computers – Methods and Strategies.

Total Periods:45

TEXTBOOKS:

- 1.Mikell. P. Groover, “Automation, Production and Systems and Computer Integrated Manufacturing” Prentice Hall of India Pvt. Ltd 2002 Ed.
- 2.Radhakrishnan P and Subramanyam. S CAD/CAM/CIM Wiley Eastern Ltd., 2000

REFERENCES :

- 1.YoramKoren, Computer Integrated Manufacturing Systems McGraw Hill 1998.
- 2.P.N.Rao, Tewari, Kundra Computer Aided Manufacturing Tata McGraw Hill 1993

Course Code MCD204	Course Name:COMPUTER AIDED MACHINE	L	T	P	C
	ELEMENT DESIGN				
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: MACHINE DESIGN I & II				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To impart adequate knowledge in designing transmission machine elements such as spur gears, helical gears, worm gears and etc. The student will also learn some Case studies of Design of Power Transmission System [mechanical and hydraulic systems] to reinforce their concepts					

COURSE OUTCOMES (COs)						
CO1		Learn to design machine elements				
CO2		Understand the importance of data communications in CIM environment				
CO3		Understand the concepts in multiplexing				
CO4		Identify the errors in communications and apply correction strategies				
CO5		Analyze the role of OSI model in the design of communication protocols				
Mapping of Course Outcomes with 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	M	L	L		
	CO2	L	M	L	L	
	CO3	L	L	L	L	H
	CO4	L	M	L		H
	CO5	M	L	L		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

6

INTRODUCTION

Design phases-Machine elements terminologies – Standardization, Interchangeability-Tolerances for process and function – Individual and group tolerances – fits –fits for various design situations – Design for assembly – modular constructions – Concepts of integrations.

UNIT II

6

SHAFTS

Shafts – applications – Design and analysis –Detailed design – Preparation of production drawings-integrated design of shaft, bearing and causing – Design for rigidity.

UNIT III

18

DESIGN OF MACHINE ELEMENTS USING CAD

Gears – Principles of gear tooth action – Gear correction – Gear tooth failure modes – Loads acting on gears –Stresses – Design of various types of gears – spur, helical, bevel and worm gears – Design of subassembly – Integrated design of speed reducers and multi speed gear boxes – Design using software packages.

UNIT IV

5

CLUTCHES

Integrated design of automobile clutches – over running clutches

UNIT V

5

BRAKES

Vehicle braking – Analysis- Dynamic and thermal aspects-Integrated design of brakes for machine tools. Automobiles and mechanical handling equipments.

Total Periods: 45

TEXTBOOKS:

1. T.J. Prabhu “Fundamentals of Machine Design 2002
- 2.T.J. Prabhu ,Design of Transmission element 2003

REFERENCES :

- 1.Shigley.J.E.Mechanical Engineering Design “McGraw Hill 1996
- 2.Juvinall. R.L.C Fundamentals of Machine component Design
John Wiley 1998.
- 3.Maitra. G.M. ‘‘Hand book for Gear Design’’, Tata McGraw Hill, 1998.
- 4.Newcomb. T.P. and Spur. R. T., ‘‘Automobile brakes and braking system’’, chapman and Hall,
2nd edition, 1975.

Course Code MMD2L1	Course Name:DESIGN AND ANALYSIS LAB				L	T	P	C
	Total Contact Hours: 60				0	0	4	2
	Prerequisite: CAD LABORATORY I							
	Course Designed by : Dept. of Mechanical Engineering							
OBJECTIVES								
1. Enhance interest in learning the design and analysis of components using software’s such as Pro-E, Ansys and MATLAB etc.								
2. Understand the various concepts of analysis of mechanical systems.								
3. Understand the concepts of finite element analysis involving mechanical, structural and thermal related problems								
COURSE OUTCOMES (COs)								
CO1	Develop the concepts and design the machine elements.							
CO2	Analyze any mechanical components and visualize the results.							
CO3	Take up any FEA related work and can solve it efficiently.							
CO4	Can do c-program for different structures truss beam and frame problems.							
CO5	Can solve problems using MATLAB.							
Mapping of Course Outcomes with 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	L				H		
	CO2		H					
	CO3			M				
	CO4							
	CO5							
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

1. Write a C program for
 - (i) Truss problems
 - (ii) Beam problems
 - (iii) Frame problems
2. Deflection of beams
 - (i) Simply supported Beam
 - (ii) Cantilever Beam
3. Combined loading problems. Eccentric loading problem.
4. Analysis of frames
5. Moment of Intertia and center of gravity of complex structures
6. Torsion of circular shaft.
7. Stresses and strains for varying sections.
8. Shell problems
9. Vibration problems
10. 3-D problems
11. Using MATLAB
 - (i) Find velocity and acceleration for simple mechanisms
 - (ii) Solution to the position of a four bar linkage
 - (iii) Dynamics simulation of slider crank mechanism
 - (iv) Design of four bar mechanism.

Total Periods: 60

Course Code MMD001	Course Name: VIBRATION CONTROL AND CONDITION MONITORING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
Gain knowledge on fundamentals of various degrees of freedom. Understand the concept of active vibration control. Learn condition based maintenance principles and applications. Gain knowledge on dynamic balancing and alignment of machinery. Gain knowledge on					

vibration control.						
COURSE OUTCOMES (COs)						
CO1	Fundamentals of various degrees of freedom.					
CO2	Active vibration control.					
CO3	Condition based maintenance principles and applications.					
CO4	Dynamic balancing and alignment of machinery					
CO5	Vibration control.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4		M			
	CO5					H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

INTRODUCTION

Fundamentals of single degree of freedom systems – two degree of freedom systems – multi degree of freedom systems – continuous systems – determination of natural frequencies and mode shapes – numerical methods in vibration analysis.

UNIT – II

VIBRATION CONTROL 9

Introduction – reduction of vibration at source – control of vibration – structural design – material selection – located additions – artificial damping – resilient isolation – vibration – isolation – vibration absorbers.

UNIT – III

ACTIVE VIBRATION CONTROL 9

Introductions – concepts and applications – smart materials – types and characteristics smart structures – characteristic active vibration in smart structures.

UNIT – IV

CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS 9

Introduction – condition monitoring methods – the design of information system, selecting methods of monitoring, machine condition monitoring and diagnosis – vibration severity criteria – machine maintenance techniques – machine condition monitoring techniques – vibration monitoring techniques – instrumentation systems – choice of monitoring parameter.

UNIT – V

DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY 9

Introduction, Dynamic balancing of rotors, field balancing in one plane two planes and in several planes – machinery alignment, “Rough” alignment methods – the face peripheral dial indicator method – reverse indicator method.

Total Periods: 45

References:

1. SINGIRESU S. RAO “Mechanical Vibration’ Addison – Wesley publishing co, 1995.
2. RAO. J.S. “Vibratory conditional monitoring of machines” CRC Press 2000.
3. J.O. Den hartog – “Mechanical Vibrations” “McGraw Hill Newyork, 1985.
4. SCIENCE ELSEVIER – “Hand Book of condition monitoring” ELSEVIER SCIENCE 1996.

Course Code MMD201	Course Name: ADVANCED DESIGN OF TRANSMISSION SYSTEM	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To impart adequate knowledge in designing transmission machine elements such as spur gears, helical gears, worm gears and etc. The student will also learn some Case studies of Design of Power Transmission System [mechanical and hydraulic systems] to reinforce their concepts.					
COURSE OUTCOMES (COs)					
CO1	The students will be able to Select / Design of various Mechanical and hydraulic				

	Power transmission system in real life industrial environment					
CO2	The students will be able to think logically to design the various Mechanical and hydraulic Power transmission system which will enhance the efficiency and effectiveness of the industries.					
CO3	: In general the students will be able face the challenges of the industrial environment by Selecting/ using the right drive or transmission element					
CO4	After learning this Course the student will understand the Detail Design Procedure the Transmission Systems – Mechanical, Hydraulic, Pneumatic general description and comparison.					
CO5	The student will also learn some Case studies of Design Of Power Transmission System [mechanical and hydraulic systems] to reinforce their concepts					
Mapping of Course Outcomes with 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
	CO2		H			
	CO3			M		
	CO4					
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

Profile correction of gears – Types of corrected gearing – Design of internal 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.

UNIT IV

Design of friction drives - Rating of Spur, Helical and Worm gears.

UNIT – V

Design of Spur helical, bevel and worm gear speed reducers – Design of Bearing and shafts – Layout of the reducer. This unit should carry 40 marks).

References:

1. T.J. Prabhu , Design of transmission Elements 2002
2. Handbook of gear design – MaitraTMH , 1994.
3. PSG Design Data Book 2003.

Course Code MMD205	Course Name: MACHINE TOOL DESIGN	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
Understand the importance of tool design for productive manufacturing and the basic procedure of tool design, drafting of tool drawing etc.					
Bring in the required properties in the tool material by proper selection and heat treatment appropriate to the cutting process adopted.					
Understand the concepts of tolerance and make use of gauges to measure the same Understand the design concepts of Jigs & Fixtures					
Get proper knowledge in the latest area of tooling for CNC machines					
COURSE OUTCOMES (COs)					
CO1	The conventional practice and procedures adopted for tools & Design such as problem statement, Drafting Hole location, Bush installation etc is understood				

CO2		The knowledge on materials for cutting tools, heat treatment required for different materials and different types of tools is obtained				
CO3		The design of dies, gauges and the importance of tolerance in the manufacturing and inspection of dies & gauges is understood				
CO4		Jig & Fixtures design for all type of machine tool is done appropriately.				
CO5		Tooling for CNC machine tools and automatic machine are also made effectively				
Mapping of Course Outcomes with 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	L				H
	CO2	M	H			
	CO3			M		H
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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.

Course Code MCD002	Course Name: CONCURRENT ENGINEERING		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite: PRODUCT DESIGN AND DEVELOPMENT/ PROCESS PLANNING					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES : • Market share and profitability are the major determinants of the success of any organization. • The factors that influence and improve the competitive edge of a company are unit cost of products, quality, and lead time. • Concurrent engineering (CE) has emerged as discipline to help achieve the objectives of reduced cost, better quality, and improved delivery performance. CE is perceived as a vehicle for change in the way the products and processes are designed, manufactured, and distributed.						
COURSE OUTCOMES (COs)						
CO1		Concurrent engineering is a management and engineering philosophy for improving quality and reducing costs and lead time from product conception to product development for new products and product modifications				
CO2		Understand the need of concurrent engineering and strategic approaches for product design				
CO3		Apply concurrent design principles to product design.				
CO4		Design assembly workstation using concepts of simultaneous engineering.				
CO5		Design automated fabricated systems – 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
2	CO1	H	H	M	L	

	CO2	M	M	H	M	L
	CO3	H	H	H	M	
	CO4	M	M	H	M	
	CO5	H	H	M	L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – 1

INTRODUCTION

6

Concurrent Engineering – Detailed definition – CE design methodologies – Organization for CE – CE tool box collaborative product development.

UNIT II

INFORMATION TECHNOLOGY AND CONCURRENT ENGINEERING

9

Use of IT in CE – Solid modeling – Product data management – Collaborative product commerce – Artificial intelligence – Software & hardware- co – design.

UNIT- III

DESIGN STAGE

10

Life cycle – design of products – Opportunity for manufacturing enterprises – Modality of CE – Automated analysis idealization control – Concurrent engineering in optimal structural design – real time constraints.

UNIT – IV

MANUFACTURING CONCEPTS AND ANALYSIS

10

Manufacturing competitiveness – Checking the design process – Mechanism of conceptual design – Qualitative physical approach – JIT system – low inventory – Modeling and reasoning for computer based assembly planning – Design of automated manufacturing system.

UNIT – V

PROJECT MANAGEMENT

10

Life cycle semi realization – Design for economics – Design evaluation for manufacturing cost – Concurrent mechanical design – Decomposition in concurrent design – Negotiation in concurrent engineering design studies – Product realization taxonomy – Plan for project management on new development – Bottleneck technology development.

Total Periods: 45

TEXTBOOK:

1. Prasad, “Concurrent Engineering Fundamentals : Integrated Product Development”, Prentice Hall, 1996.

REFERENCES:

1. AndrewKusaik, “Concurrent Engineering : Automation Tools and Technology”. Wiley John and Sons Inv., 1992.
2. Anderson MM and Hein. L. Berlin. “Integrated Product Development.” Springer Verlog. 1987.

Course	Course Name: TOOL DESIGN	L	T	P	C
Code	Total Contact Hours: 45	3	0	0	3
MMD003	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES Understand the importance of tool design for productive manufacturing and basic procedure of tool design, drafting of tool drawing etc., Bring in the required properties of the tool material by proper selection and heat treatment appropriate to the cutting process adopted. Understand the concepts of tolerance and make use of gauges to measure the size. Understand the design concepts of Jigs & Fixtures Get proper knowledge in the latest area					

tooling for CNC machines						
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					
CO4	Understand the design concepts of Jigs & Fixtures					
CO5	Get proper knowledge in the latest area of tooling for CNC 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	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4		L			
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Mechanics of chip formation – chip control-chip breakers – cutting forces and measurements
Merchant's theory – specific cutting energy – shear angle – theory of Lee and Shaffer – friction in
cutting – measurements of cutting temperatures – influence of tool geometry on cutting forces.

UNIT – II

8

Tool materials – composition – selection and treatments – cutting fluids selection and types - tool
wear determination – tool life – Taylor's formula – feed, speed & depth of cut – life based
on volume.

UNIT – III

Design of single point cutting tool – design of multipoint cutting tools – form tools – drills,
milling cutters and broaches.

UNIT – IV

Design of simple, progressive compound dies – bending dies – bend allowances – bending
pressure – metal flow in drawing – drawing force – single and double section draw dies – forging
and dies.

UNIT – V

Design of blanking and piercing Dies – Die cutting operations – press tools power press types –
cutting action in punch and die operation – die clearance – die construction centre of pressure –
scrap strip layout – pilots – stripers and pressure pads – tooling for piercing.

Total Periods: 45

Reference:

1. Donaldson tool design 3rd edition, TMH, 1973.
2. Sen and Bhattacharya, principles of metal cutting CBS, 1995.
3. Basu, U- Fundamentals of tool engineering design oxford and IBH, 1990.
4. Colei B.C-tool design.
5. Nagpal GR-Tool engineering and design, khanna publication, 1999

Course Code MMD202	Course Name: TRIBOLGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To provide broad based understanding of the interdisciplinary subject ‘tribology’ and its technological significanceTo understand the nature of engineering surfaces, their topography					

and learn about surface characterization techniques. To learn about the contact of solid surfaces and their interactions. To understand the genesis of friction, the theories/laws of sliding and rolling friction. To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.

COURSE OUTCOMES (COs)

CO1	Will be able to apply the principles of lubrication, lubrication regimes, and theories of hydrodynamic, elastic hydrodynamic and mixed / boundary lubrication
CO2	Will have knowledge of tribo testing and experimental techniques in Tribology.
CO3	Will have knowledge about tribological modeling and simulation
CO4	To understand the genesis of friction, the theories/laws of sliding and rolling friction.
CO5	To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear 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
2	CO1	H				H
	CO2		H			
	CO3			M		
	CO4					
	CO5	H			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

SURFACE FRICTION AND WEAR

11

Topography of the surfaces, . Surface features, surface interaction , Friction – Sliding and rolling friction – Friction properties of Metallic and non Metallic Materials – Friction in extreme conditions – Wear – Types – Mechanism – Wear resistance Materials – Surface treatment – Surface Modifications – Surface coatings.

UNIT – II

ROLLING ELEMENT BEARINGS

12

Geometry And Kinematics – Material And Manufacturing Processes – Contact Stress – Hertzian stress equations – stresses and deflections – axial loads and rotational effects, life capacity – variable loads – oil films – effects – Rolling Bearing failure.

UNIT – III

LUBRICATION THEORY

11

Lubricants and their properties – Reynolds equations – thermal, inertia and turbulent effects – elastoplasto and magneto hydrodynamic lubrication – hydrostatic lubrication – gas lubrication.

UNIT – IV

DESIGN OF FLUID FILM BEARING

11

Design and performance – thrust and journal bearings – full. Partial, fixed and pivoted. Bearings. Lubrication flow and delivery – power loss – heat and temperatures rotating loads and dynamic loads – hydrostatic bearing design.

Total periods: 45

References:

1. CAMERON, A Basic Lubrication Theory”. ELLIS Herward LTD. UK. 1981.
2. WILLIAMS. J.A. “Engineering Tribology” Oxford Univ Press 1994.
3. HULLING.J. (Editor) – ‘Principles of Tribology’ Macmillan (1984).
4. PSG Design Data Book, 2003.

Course Code MMD203	Course Name: DESIGN OF PRESSURE VESSELS AND PIPING					L	T	P	C
	Total Contact Hours: 45					3	0	0	3
	Prerequisite:								
	Course Designed by : Dept. of Mechanical Engineering								
OBJECTIVES To understand the different types of stresses and their effects in pressure vessel. To understand the piping layout and the stresses acting on it.									
COURSE OUTCOMES (COs)									
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			
2	CO1	L				S			
	CO2		H						
	CO3			M					
	CO4	H			L				
	CO5								

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

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 VESSELS

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 – autofrettage – 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.

WILLIAM J. BEES ‘Approximate methods design and analysis of pressure vessels and piping’. Piping Conference 1997

Course Code MMD206	Course Name: DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To know the advantages and applications of Fluid Power Engineering and Power Transmission System.					
To learn the Applications of Fluid Power System in automation of Machine Tools and other Equipments					
COURSE OUTCOMES (COs)					

CO1		Identify hydraulic and pneumatic components.				
CO2		Ability to design hydraulic and pneumatic circuits				
CO3		Demonstrate good grounding in the subject area of fluid power				
CO4		Appreciate the circuits and feel the advantages over the similar mechanical systems				
CO5		Gain knowledge regarding the use of special control and regulation element				
Mapping of Course Outcomes with 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
	CO2		H			
	CO3			M		
	CO4					
	CO5	L		L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

PUMPS

3

Hydraulic power generator – selection and specification of pumps, pumps and characteristics.

UNIT – II

HYDRAULIC ACTUATORS

5

Linear and Rotary Actuators – Selection, specification and characteristics.

UNIT – III

CONTROL AND REGULATION ELEMENT

6

Pressure direction and flow control valves, relief valves, non return and safety valves, actuation systems.

UNIT – IV

HYDRAULIC AND PNEUMATIC CIRCUITS

12

Reciprocation, quick return, sequencing circuits, synchronizing circuits, Accumulator circuits – industrial circuits – press circuits, Hydraulic milling machine, grinding, planning, copying, fork lift. Earth mover circuits – Design and selection of components – safety and emergency mandrels.

UNIT – V

PNEUMATIC SYSTEMS AND CIRCUITS

10

Fundamentals – control elements. Position and pressure sensing – logic circuits – switching circuits, Fringe condition modules and these integration, sequential circuits – cascade methods – mapping methods – step counter method – compound circuits design, combination circuit design.

UNIT – VI

INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

9

Pneumatic equipments – selecting of components – design calculations – application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC-low cost automation – Robotic circuits.

Total Periods: 45

References:

1. Antony Esposho “Fluid Power with Applications” Prentice Hall 1980.
2. DUDLEY T. A Pease and JOHN. J. PIPPENGER “Basic Fluid Power” Prentice Hall 1987.
3. Andrew Parr. “Hydraulic and Pneumatics’ Jai Co Publishing House. 1999
4. Bolton W. ‘Pneumatic and Hydraulic Systems’ Butter Worth – Heinemann – 1997.
5. James L Johnson, Introduction to fluid power, Esver press 2003

Course Code MCD003	Course Name: DESIGN FOR MANUFACTURING		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:MANUFACTURING TECHNOLOGY					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To educate students a clear understanding of factors to be considered in designing parts and components with focus on manufacturability						
To know the concept of design for manufacturing, assembly and environment.						
To know the computer application in design for manufacturing and assembly						
COURSE OUTCOMES (COs)						
CO1	To make the students get acquainted with the design for manufacturing, assembly and environment					
CO2	Can do design alteration for preparing components based on casting process					
CO3	Can do design alteration for preparing components based on forging process					
CO4	Can do design alteration for preparing components based on welding process					
CO5	Can do design alteration for preparing components based on machining 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	L				H
	CO2		H			
	CO3			M		
	CO4		L			
	CO5					L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

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

UNIT-I INTRODUCTION

9

General design principle for manufacturability – Process capability – Surface finish – Tolerances – Feature tolerance – Cumulative effect of tolerances – Surefit, Normal & Fruncated normal laws – Geometric tolerances.

UNIT -II

FITS AND ASSEMBLIES

Fits – Universal interchangeability – Selective Assembly – control of axial play – Second stage machining - laminated – Automated assemblies – Grouped datum systems Deciding the number of groups, Types.

UNIT –III

9

POSITION THEORIES

True position theory- Virtual size concept – True position tolerancing – Fixed fasteners – Floating fasteners – Zero true position tolerances – functional gauging – Paper layout gauging.

UNIT-IV

9

DESIGN

Form design of castings - Redesigning – Parting line consideration – Minimizing core requirements – Economic design of castings – Form design of weldments. – Welding symbols – Redesigning cast members using weldments- Economic weldments.

UNIT-V

9

DESIGN FOR MACHINING/ASSEMBLY & INSPECTION

Design for assembly – Design for inspection – Design for machining – Redimensioning based on manufacturing datums – Design to reduce value addition – Parts cut to length – Machined round holes – Blind & Through holes – Design consideration for various machining operations.

Total Periods: 45

TEXTBOOKS :

1. M.F. SPOTTS- “ Dimensioning & tolerancing for quantity production” – Prentice Hall
2. HARRY PECK- “ Designing for manufacture” – Pitman publications, 1973.

REFERENCES:

1. JAMES G. BRALLA – “ Hand Book of Product Design for Manufacturing.”

Course Code MCD004	Course Name: PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To impart knowledge regarding trends in operation management, layout planning,Scheduling system					
COURSE OUTCOMES (COs)					
CO1	an forecast trends in operation management.				
CO2	Can do layout planning.				

CO3	Can do project management.					
CO4	Capable of inventory control					
CO5	Capable doing of master scheduling etc.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT –I

9

Introduction – trends in operation management – careers in production management – planning productivity and quality – forecasting.

UNIT – II

9

Layout planning – types – developing the layouts – manufacturing cellular layout – improved performances – job design – production and operation standards – work measurement.

UNIT – III **9**

Project management – project planning project scheduling models – pert – CPM – solving a project personal computer package

UNIT – IV **9**

Scheduling systems – Aggregate planning process – master scheduling – rough cut capacity planning – implementing Aggregate plans and master schedules.

UNIT – V **9**

Inventory control fundamentals – control application – material requirements planning – manufacturing resource planning – quality analysis and control

Total periods: 45

References:

1. Everff e Adam Jr. Ronald.J Ebert “production and operation management “PHI fifth edition 1992
2. Chary S.N “theory and problems in production and operation management “TMH 1997.
3. Panneerselvam.R.”Productions and operations management “PHI, 1999
4. Buffa.E. “Modern production / operational management “John Wiley & Sons, 7th edition
5. Saravanavel .P. and Sumathi.S “production and materials management “Margham publications, Chennai-2000

Course	Course Name: DESIGN OF JIGS AND FIXTURES	L	T	P	C
Code	Total Contact Hours: 45	3	0	0	3
MMD004	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
1. Understand the importance of tool design for productive manufacturing and the basic procedure of tool design, drafting of tool drawing etc.,					
2. Bring in the required properties in the tool material by proper selection and heat					

treatment appropriate to the cutting process adopted.						
3. Understand the concepts of tolerance and make use of gauges to measure the same						
4. Understand the design concepts of Jigs & Fixtures						
5. Get proper knowledge in the latest area of tooling for CNC machines.						
COURSE OUTCOMES (COs)						
CO1	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					
CO4	Understand the design concepts of Jigs &Fixtures .					
CO5	: Get proper knowledge in the latest area of tooling for CNC 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	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		

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

UNIT - I

Location and clamping devices – principles – need – types of location devices – types of clamping devices – clamping forces – hydraulic and pneumatic clamping systems.

UNIT – II

Fixtures – design principles – types of fixtures – fixtures for machine tools – lathe , milling, boring , and broaching.

UNIT - III

Fixtures for grinding, assembly, shaping, welding and inspection – clamping & other forces – designing.

UNIT – IV

Jigs – objectives – design principles – types of drill jigs – chip control – drill bushing – advantages and limitations.

UNIT – V

Calculation of forces – design of drill jigs – leaf, box, plate – indexing and universal jigs.

Total periods: 45

References:

1. DONALDSON .C. Tool Design – Tata McGraw Hill Col Ltd, 1973.
2. KEMPSTER .Introduction of tool design and Jigs And Fixtures, ELBS, 1974.
3. Hiram .E. Grant – Jigs and Fixtures, TMH, 1971.
4. Korakow – fundamentals of jigs and fixtures, MIR publication, 1985.
5. Joshi .P.H. Jigs and fixtures TMH, 1990

Course	Course Name: DESIGN OF MECHANISMS – I	L	T	P	C
Cod MMD103	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				

	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
To include dynamics considerations in the design of mechanisms for engineering applications is the objective of this course.						
COURSE OUTCOMES (COs)						
CO1	Understand basic principles of Mechanism and machines.					
CO2	Develop schematic models for physical systems and formulate governing equations of motion					
CO3	Understand the three dimensional linkages and coupler curves					
CO4	Understand and Analyze the various gear trains					
CO5	Understand the principles of cam 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
2	CO1	L				S
	CO2		H			
	CO3			M		
	CO4					L
	CO5				H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

MECHANISMS & MACHINES BASIC CONCEPTS

9

Mechanism – Tools for design of linkages & other mechanism – DOF (mobility) – transmission angle – Grashof criterion – Quick return mechanism – Limiting positions – Mechanism for specific applications.

UNIT – II

ANALYSIS OF MECHANISMS

9

Displacement analysis of linkages – Complex number methods applied to velocity analysis – Analyzing combinations of basic linkages – Trial solutions & inverse methods – Acceleration analysis – Analysis of a four bar linkage using analytical vector method – Spatial linkage – Types – Analysis of four link spatial linkages.

UNIT – III

3D GEOMETRY & SPATIAL MECHANISM

9

Three dimension & its Cartesian system – Algebraic Surfaces & Special curves – Algebraic special linkages – Quadratic surfaces – Ruled surfaces – Degree of ruled surfaces – Curvature of surface & spatial curves – Special coupler curves.

UNIT – IV

DRIVE TRAINS – DESIGN & ANALYSIS

9

Velocity ratios for Spur & Helical gear trains – Speed ratio – Planetary gear trains – Other gear train elements – Velocity & Acceleration a planetary train – Forces, torque & Transmitted power in gear trains.

UNIT – V

CAMS & GEARS – DESIGN & ANALYSIS

9

Graphical cam design – Analysis of cam follower motion – Analytical cam design – Practical considerations in cam design – Fundamental law of gearing – Sliding action of gear tooth forces.

Advanced cam profile techniques – Graphical & Analytical cam profile synthesis – Cam modulated linkages.

Total Periods: 45

References:

1. Arthur G. Erdman, Goerge N. Sanctor – Mechanism Design Vol I & II Prentice Hall – 1997.
2. Charles E. Wilson J. Peter Seidler – Kinematics & Dynamic of Machinery, Second Edition.
3. K H. Hurt – Kinematic Geometry of Mechanisms, Oxford University Press 1978.

Course	Course Name: ENGINEERING DESIGN		L	T	P	C
Code	Total Contact Hours: 45		3	0	0	3
MMD105	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
This course enables the student to identify failure modes and evolve design by analysis methodology. Design against fatigue failure is given explicit attention.						
COURSE OUTCOMES (COs)						
CO1	Understand the ethics followed during Engineering Design process.					
CO2	Illustrate the methods to define the customer needs					
CO3	Identify the sources of information to support and accelerate Engineering design process					
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept					
CO5	Express the basic concept of Embodiment Design to translate conceptual designs to Engineering 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	L				H
	CO2		H			
	CO3			M		
	CO4		H			

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

UNIT – I

MATERIALS SELECTION

9

Mathematical modeling – Dimensional Analysis – Simulation – Material Selection – Methods of Material Selection Process – Selection with Computer Aided databases – Material performance indices – Decision matrices – Material selection by Expert systems – Value analysis – Recycling – Materials in design – Design for Fatigue failure – Brittle fracture – Corrosion resistance – Brittle materials – Plastics.

UNIT – II

PROCESS SELECTION

9

Role of processing in design o Design for Manufacturability & Assembly – Computer methods for DFM and DPA – Design for Casting – Forging- Sheet metal forming – Machining – powder Metallurgy – Welding Design for Heat treatment – Plastics processing – Residual stresses in design .

UNIT – III

STATISTICS AND DESIGN

9

Engineering statistics & design – Probability – Errors & samples – Frequency distribution – Measure of central Tendency and Dispersion – Normal distribution – Weibull and other frequency distributions – Sampling distributions – Statistical tests of Hypotheses – Statistical intervals – Analysis of variance – Statistical design of experiment – Regression analysis .

UNIT – IV

RELIABILITY AND QUALITY OF DESIGN

9

Reliability theory – Design for reliability – FMEA – Fault free analysis – Defects and failure modes – Failure analysis – Design for safety – Quality control and assurance – Quality improvement – Statistical process control – Taguchi method – Design optimization.

UNIT – V

COSTING IN DESIGN

9

Decision making – Time value of Money – cost comparison – inflation – Sensitivity & Break even analysis – Categories of costs – Methods Costintexes – Cost capacity factors – Estimating plant cost – Design to cost – Manufacturing costs – Value analysis in costing - over head costs – cost models – Life cycle costing.

Total Periods: 45

References:

1. GEORGE.E.DIETER Engineering Design ‘3rd Edition – McGraw Hill international Editions-2000.
2. Michel F. Ashby. “Materials Selection in Machine Design “. II edition
3. AchinyaHalder, SomkasamMahadeven, “Probability, Reliability and “Statistical Methods in Engineering “, John Wiley and Sons.
4. YousufHaik, Engineering Design Process “, First Print 2003.

Course Code MMD002	Course Name: DESIGN OF MATERIAL HANDLING EQUIPMENTS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To impart adequate knowledge regarding the design of material handling equipments such hoist conveyor, elevators etc					
COURSE OUTCOMES (COs)					
CO1	Can design material handling equipments				
CO2	Can design drives of hoisting gears				
CO3	Can design conveyors				
CO4	Can design elevators				
CO5	Can design different brakes for material handling equipments.				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low					

1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

MATERIAL HANDLING EQUIPMENT

4

Types, selection and applications

UNIT – II

DESIGN OF HOISTS

15

Hoisting, elements – wheeled and roller chains – hemp and wire ropes – factors to be considered in design of ropes. Pulleys, pulley system, sprockets and drums – load handling attachments – design of forged hooks and eye hooks – crane grabs – lifting magnets – grabbing attachments – design of arresting gear – brakes shoe, band and cone types.

UNIT – III

DRIVES OF HOISTING GEAR

6

Hand and power drives – travelling gear – rail traveling mechanisms – cantilever and monorail canes – slewing, jib and fluffing gear – cog wheel drive motor rating selection.

UNIT – IV

CONVEYORS

10

Types – description – design and application of belt conveyors – apron conveyors and escalators – pneumatic, screw & vibratory conveyors.

UNIT – V

ELEVATORS

10

Types – description – bucket elevators – arrangements – cage elevators – shaft ways guides counter weighty – hoisting machine – safety devices – forms lift trucks.

Total Periods: 45

References:

1. Rudenko N Material handling equipment, Elnvee Publishers 1981
2. Spivakovsy A.O. and Dyachkov V.K. Conveying machines, volume I and II, MIR Publishers, 1985.

3. Alexandrov M. Material Handling Equipment, MIR Publisher, 1981.

Bolizharol. A. Material handling handbook, The Ronald Press Company, 1958.

Course Code ED7003	Course Name: COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.Implementation of Classical Laminate Theory (CLT) to study and analysis for residualStresses in an isotropic layered structure such as electronic chips					
COURSE OUTCOMES (COs)					
CO1	1. To understand the fundamentals of composite material strength and its mechanical behavior				

	Stresses in an isotropic layered structure such as electronic chips.					
CO2	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.					
CO3	Thermo-mechanical behavior and study of residual stresses in Laminates during processing					
CO4	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips.					
CO5	At the end of the course the students will be in position to understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropiclayered structures (example electronic chips) etc and its manufacturing methodologies.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers,inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures- Characteristics of fiber-Reinforcedcomposites, Manufacturing fiber and composites,

UNIT II MANUFACTURING OF COMPOSITES 10

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation-interfaces

UNIT III INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS 12

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke’s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF

LAMINATED FLAT PLATES 8

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill’s Criterion for Anisotropic materials. Tsai-Hill’s Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT V THERMAL ANALYSIS 5

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke’s Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E’s. C.T.E’s for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

TOTAL: 45 PERIODS

REFERENCES

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994,
Second Edition - CRC press in progress.
2. Hyer, M.W., “Stress Analysis of Fiber – Reinforced Composite Materials”, McGraw-Hill,
1998
3. Issac M. Daniel and OriIshai, “Engineering Mechanics of Composite Materials”,
Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber –”Reinforced Composites: Materials, Manufacturing and Design”,
Maneel
Dekker Inc, 1993.
5. Halpin, J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co., 1984.
6. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John
Wiley and Sons, New York, 1990.
7. Mallick, P.K. and Newman, S., (edition), “Composite Materials Technology: Processes and
Properties”, Hansen Publisher, Munish, 1990.
8. MadhujitMukhopadhyay, “Mechanics of Composite Materials and Structures”, University
Press
(India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)
9. Chung, Deborah D.L., “Composite Materials: Science and Applications”, Ane Books Pvt.
Ltd./Springer, New Delhi, 1st Indian Reprint, 2009

Course Code	Course Name:ENGINEERING FRACTURE MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

MMD005		Prerequisite:				
		Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions. To impart knowledge on mechanics of cracked components of different modes by which these components fail under fatigue load conditions.						
COURSE OUTCOMES (COs)						
CO1		It helps the engineers to get familiarized with the design of components that contain crack under static load condition				
CO2		Identify and formulate the stress intensity factor ((K) for typical crack configurations				
CO3		Define the near field equations to determine the stress-strain and load-displacement fields around a crack tip for linear elastic cases.				
CO4		Identify and formulate the strain energy release rate (G).Identify and formulate J-integral and the stress and strain fields around a crack tip for non linear				
CO5		Employ the standard and non standard fracture mechanics tests to determine the fracture Toughness 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	L				H
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					

REFERENCES:

1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 1978.
2. KareHellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
4. John M.Barson and StanelyT.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1977
5. TribikramKundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 1st Indian Reprint, 2012

Course	Course Name: ROBOTICS	L	T	P	C
Code	Total Contact Hours: 45	3	0	0	3
MAE002	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To study robot organizations.To study basics of artificial intelligence. To study at robotic vision systems.					
COURSE OUTCOMES (COs)					

CO1	Define basic concepts in modeling and simulation (M&S)					
CO2	Classify various simulation models and give practical examples for each category					
CO3	Construct a model for a given set of data and motivate its validity					
CO4	Generate and test random number varieties and apply them to develop simulation models.					
CO5	Analyze output data produced by a model and test validity of the model.					
Mapping of Course Outcomes with 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	L				S
	CO2		H			
	CO3			M		
	CO4	L				
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I

ROBOT ORGANIZATION

9

Coordinate transformation, kinematics and inverse kinematics, Trajectory planning and remote manipulation

UNIT-II ROBOT HARDWARE**9**

Robot sensors, proximity sensors, Range sensors, visual sensors, Ausitory sensors, Robot manipulators, Manipulator dynamics , Manipulator control, acts, end efforts, Robot grippers.

UNIT III ROBOT AND ARTIFICIAL INTELLIGENCE**9**

Principles of AI , Basics of learning, planning movement, Basics of knowledge presentations, Robot programming languages.

UNIT IV**ROBOTIC VISION SYSTEMS****9** Principles

of edge detection, Determining optical flow and shape, Image presentation, pattern recognition, Model directed scene analysis

UNIT V ROBOT CONTROL AND APPLICATION**9**

Robot control using voice and infrared, overview of robot applications, prosthetic devices, Robots in material handling, processing assembly and storage.

Total Periods: 45

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Text Books:

1. Koren, "Robotics for Engineers", MC Graw Hill International company, Tokyo, 1995
2. Vokopravotic, "Introduction to Robotics", Springer, 1998
3. Rathmill K, "Robot Technology and Application", Springer, 1985

Course Code MAE002	Course Name: SYSTEM MODELLING AND SIMULATION	L	T	P	C	
	Total Contact Hours: 45	3	0	0	3	
	Prerequisite:					
	Course Designed by : Dept. of Mechanical Engineering					
OBJECTIVES						
COURSE OUTCOMES (COs)						
CO1	Classify various simulation models and give practical examples for each category					
CO2	Construct a model for a given set of data and motivate its validity					
CO3	Generate and test random number varieties and apply them to develop simulation models.					
CO4	Analyze output data produced by a model and test validity of the model.					
CO5	Explain the concept of output analysis of single model.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H	H	M	H
	CO2		M	H	H	H
	CO3	M		M	M	M
	CO4	M	H	H	H	H
	CO5					M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

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

UNIT -I

12

INTRODUCTION TO SIMULATION

Advantages and disadvantages of simulation, areas of application, System environment, Components of a system. Discrete and continuous systems, model of a system. Types of models. Steps in a simulation study, simulation examples: simulation of queuing systems, simulation of inventory systems. Discrete event simulation, general principles and computer simulation languages. FORTRAN, SIMSCRIPT, GPSS.

UNIT-II

12

STATISTICAL MODELS IN SIMULATION

Review of terminology and concepts. Useful statistical models, discrete distributions, continuous distributions. Poisson process, Empirical distributions, Queuing models: Characteristics of queuing systems, queuing notations. Transient and steady state behaviour of queues, steady-state behaviour of infinite population, Markovan models, Steady state behaviour of finite population models.

UNIT-III

12

INVENTORY SYSTEMS

Measures of effectiveness, inventory policies, deterministic systems probabilistic systems, simulation in inventory analysis. Random number generation. Properties of random numbers. Generation of pseudo-random numbers. Tests for random numbers. Random variate generation: Inverse transform technique, Direct transform for the normal distribution, convolution method. Acceptance-Rejection technique.

UNIT-IV

12

INPUT DATA ANALYSIS

Data Collection, Identifying the distribution, Parameter estimation, Goodness-of-fit tests, Verification and validation of simulation models: Models Building, calibration and validation of models.

OUTPUT ANALYSIS FOR A SINGLE MODEL

Stochastic nature of 0/1 data, types of simulations with respect to O/P analysis, Measures of performance and their estimation, O/P analysis for terminating simulations, O/P analysis for steady-state simulations.

TOTAL NO OF PERIODS: 60

TEXT BOOKS

- 1) Jerry Banks, Carson. J.S., and Nelson B.L., “Discrete Event System Simulation”, Prentice Hall of India, New Delhi, 2006.
- 2) Karian, Z. A., Dudewicz, E. J. (112121), “Modern statistical systems, and GPSS simulation: the first course”, W. H. Freeman and Company, New York, 2005.

REFERENCES

1. System Modelling and Simulation, V.P.Singh, New Age International Publishers,2009.
2. <https://Shamsulsarip.Files.Wordpress.Com/2015/07/System-Modelling-And-Simulation.Pdf>

3 0 0 3

Course Code MMD205	Course Name: RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To Get adequate knowledge about research concepts. To describe mathematical modeling and simulation. To understand experimental modeling. To get knowledge about interpretation of result.					
COURSE OUTCOMES (COs)					
CO1	To describe research concepts.				
CO2	To Get adequate knowledge about mathematical modeling				
CO3	To describe experimental modeling				
CO4	To understand analysis of results.				
CO5	To know about report writing				

Mapping of Course Outcomes with 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	L				H
	CO2	M	H			
	CO3			M		H
	CO4					
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. SchankFr., „Theories of Engineering Experiments“, Tata McGraw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments”, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management”, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996

Course Code ED7003	Course Name:Advanced Material Science and Failure Analysis In Mechanical Design	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combination					

plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips						
COURSE OUTCOMES (COs)						
CO1	1. To understand the fundamentals of composite material strength and its mechanical behavior Stresses in an isotropic layered structure such as electronic chips.					
CO2	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.					
CO3	Thermo-mechanical behavior and study of residual stresses in Laminates during processing					
CO4	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual Stresses in an isotropic layered structure such as electronic chips.					
CO5	At the end of the course the students will be in position to understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropic layered structures (example electronic chips) etc and its manufacturing methodologies.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				S
	CO2		S			
	CO3			M		
	CO4	L				
	CO5					

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

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.

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 AsokeK.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.

Course	Course Name: MECHATRONICS	L	T	P	C
Code	Total Contact Hours: 45	3	0	0	3
MCD005	Prerequisite:				
	Course Designed by : Dept. of Mechanical Engineering				
OBJECTIVES					
To enable the students to understand the fundamental concepts of Semi-Conductors, Transistors, Rectifiers, Digital Electronics .					
COURSE OUTCOMES (COs)					
CO1	Understand the fundamentals of mechatronic systems in a synergistic framework				
CO2	Design and develop intelligent engineered products and processes to solve challenging technological problems.				
CO3	Design and simulate mechatronic systems using microcontrollers and programmable logic controllers				
CO4	Develop innovative approaches and an entrepreneurial mind set to problem				

		solving				
CO5	Can develop data handling and data acquisition system etc.					
Mapping of Course Outcomes with Program outcomes (POs)						
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	L				S
	CO2		H			
	CO3			M		
	CO4	L			M	
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I

Introduction – systems – Measurement systems – Control system Microprocessor – Based controllers & problems.

UNIT – II

Sensors and transducers – performance – terminology – Displacement – position and proximity – velocity and motion – force – fluid pressure liquid flow – liquid level – temperature – light sensors – selection of sensors.

UNIT – III

Signal conditioning – The operational amplifier protection – filtering – wheat stone bridge – Digital signals – multiplexes – data acquisition – digital signal processing – pulse – modulation.

UNIT – IV

Data presentation system – displays – data presentation elements – magnetic recording – Displays – data acquisition systems – Measurement system – testing and calibration.

UNIT – V

Pneumatic & hydraulic system – Mechanical actuation systems.

Reference:

1. W.Bolton, Mechatronics Electronics control system in Mechanical & Electrical Engg. Addison 1999.
2. Michael – B. Histland, David. G.Aliatoce – Introduction to Mechatronics and measurement system – McGraw Hill International Edition.

CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM
M.TECH – THERMAL ENGINEERING
(FULL TIME)
I – IV SEMESTERS

SEMESTER – I							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MMA109	PM	Mathematical Methods	3	2	0	4
2	MME101	PC	Fuels, Combustion And Emission Control	3	0	0	3
3	MME102	PC	Advanced Fluid Mechanics	3	0	0	3
4	MME103	PC	Advanced Heat Transfer	3	0	0	3
5	MME104	PC	Analysis Of Thermal Power Cycles	3	0	0	3
6	MME1E1	PE	Professional Elective – I	3	0	0	3
7	MME1L1	PC	Thermal Laboratory	0	0	4	2

TOTAL CONTACT HOURS-22

TOTAL CREDIT: 21

SEMESTER – II							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MME201	PC	Fluid Mechanics of Turbo Machines	3	0	0	3
2	MME202	PC	Instrumentation	4	0	0	4
3	MME203	PC	Computational Fluid Dynamics	3	0	0	3
4	MME204	PC	Advanced IC Engines	3	0	0	3
5	MME2E2	PE	Professional Elective – II	3	0	0	3
6	MME2E3	PE	Professional Elective – III	3	0	0	3
7	MME2L1	PC	Heat Transfer Laboratory	0	0	4	2

TOTAL CONTACT HOURS-23

TOTAL CREDIT: 21

SEMESTER – III							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MME301	PC	Advanced Refrigeration And Air Conditioning Engg..	3	0	0	3
2	MME302	PC	Environmental Pollution Control	3	0	0	3
3	MME3E4	OE	Open Elective	3	0	0	3
4	MME3P1	PR	Project Work Phase I	0	0	12	6

TOTAL CONTACT HOURS-21

TOTAL CREDIT: 15

SEMESTER – IV							
S.NO.	CODE	CATEGORY	SUBJECT NAME	L	T	P	C
1	MME4P2	PR	Project Work Phase II	0	0	24	12

TOTAL CONTACT HOURS-24

TOTAL CREDIT: 12

TOTAL PROGRAMME CREDITS: 69

**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 Mathematics (PM)	4	-	-	-	4	5.80%
2	Professional Core (PC)	14	15	6	-	35	50.72%
3	Professional Electives (PE)	3	6	-	-	9	13.04%
4	Open Electives (OE)	-	-	3	-	3	4.35%
5	Project Work, Seminar, Internship, etc. (PR)	-	-	6	12	18	26.09%
	Total Credit	21	21	15	12	69	100%
	Total Contact Hour	22	23	21	24	90	

LIST OF ELECTIVES
Professional Elective –I

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MME E2	Energy Conservation, Management And Auditing	3	0	0	3

2	MME E6	Heat Transfer Equipment Design	3	0	0	3
3	MME E12	New And Renewable Sources Of Energy	3	0	0	3
4	MMD 203	Design Of Pressure Vessels And Piping	3	0	0	3

Professional Elective –II

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MME E5	Boiler Auxiliaries And Performance Evaluation	3	0	0	3
2	MME E10	Frontier Materials	3	0	0	3
3	MME E11	Combustion Engineering	3	0	0	3
4	MME E13	Nuclear Engineering	3	0	0	3

Professional Elective –III

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MME E7	Installation Testing And Operation Of Boilers	3	0	0	3
2	MME E9	Non Destructive Testing And Failure Analysis	3	0	0	3
3	MME E14	Design And Analysis Of Turbo Machines	3	0	0	3
4	MME E15	Advanced Thermal Storage Technologies	3	0	0	3

Open Elective

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MAE002	Robotics	3	0	0	3
2	MCS157	System Modeling And Simulation	3	0	0	3
3	PCD 005	Mechatronics	3	0	0	3
4	MST070	Research Methodology	3	0	0	3
5	MMD 007	Advanced Material Science And Failure Analysis In Mechanical Design	3	0	0	3

SEMESTER I

Course Code MMA 109	Course Name: Mathematical Methods				L	T	P	C
	Total Contact Hours: 60				3	2	0	4
	Prerequisite: Engineering Mathematics I, Engineering Mathematics II, Engineering Mathematics							
	Course Designed by : Department of Mechanical Engineering							
OBJECTIVES: To equip students with adequate knowledge of mathematical methods to formulate in engineering and solve them analytically and numerically								
COURSE OUTCOMES (COs)								
CO1		To Understand the principle of calculus of variations and apply to mechanical problems						
CO2		To analyze various methods of variational problems applicable to Engineers						
CO3		To Analyze the various integral equations applicable to engineers						
CO4		To evaluate various partial differential equations useful for thermal engineers.						
CO5		To analyze finite element methods and application of shape function to fluid flow and heat transfer 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		
2	CO1	M	M		H			
	CO2	L		M	H	M		
	CO3		M		H			
	CO4				H			
	CO5	L			H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

OBJECTIVE:

To equip students with adequate knowledge of mathematical methods to formulate in engineering and solve them analytically and numerically

UNIT-1

Calculus of variations - Euler's equation - Variational problems in parametric form - Natural

Boundary condition – Conditional Extremum - Isoperimetric problems.

UNIT-2 **12**

Direct methods in Variational Problems - Euler's finite difference method - Rayleigh -Ritz Method - Galerkin's method - Kantorovich's method.

UNIT-3 **12**

Integral equations - Conversion of BVP to integral equations using Green's Function - Fredholm Equation with separable kernels – Solution of Fredholm and Volterra equations by the method of Successive approximations.

UNIT-4 **12**

Finite difference scheme for elliptic, parabolic, and hyperbolic partial differential equations.

UNIT-5 **12**

Introduction to Finite Element Method - Rules for forming interpolation functions - Shape Functions Application to fluid flow and heat transfer problems.

Text book

1. GREWAL, B.S. , *Higher Engineering Mathematics*, Khanna Publishers.

References.

1. DESAI, C.S., and ABEL, J. P., *Introduction to Finite Element Method*, Van Nostrand Reinhold.
2. ELSEGOLTS, L., *Differential Equations and the Calculus of Variations*, Mir Publishers.
3. HILDEBRAND, P.B., *Method of Applied Mathematics*, Prentice Hall.
4. VENKATARAMAN, M. K., *Higher Mathematics for Engineering and Science*, National Publishing Company.

Total no of periods: 60

Course Code MME 101	Course Name: Fuels, Combustion and Emission Control	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The course is intended to • Provide Students with Knowledge of Fuel Quantity and Engine Technology Effects on Emissions. • Understand The Combustion Phenomena. • Understand The Concept of Laminar and Turbulent Flame Propagation. • Understand About Different Methods to Reduce Air Pollution					
COURSE OUTCOMES (COs)					
CO1	Have the knowledge of fuel thermo-chemistry and fuel quality effects on emissions, engine technologies, engine combustion-related emissions and control technologies				
CO2	Extend their knowledge of fuels and engines to different situations of engineering context and professional practice.				

CO3	Understand combustion in spark ignition and diesel engines.					
CO4	To identify the nature and extent of the problem of pollutant formation and Control in internal combustion engines government legislation					
CO5	To understand the principal of combustion.					
Mapping of Course Outcomes with 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	M	L	M	H
	CO2	H				M
	CO3	H	M	M	L	
	CO4	H				
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 BASICS

9

Types of fuels and their properties - Coal characterization - Combustion chemistry - Stoichiometry Heat of reaction - Calorific value - Adiabatic flame temperature - Equilibrium - Mass transfer.

UNIT-2 COMBUSTION MECHANISMS FOR LAMINAR FLOW

9

Chemical kinetics – Important chemical mechanisms – Simplified conservation equations for Reacting flows – Laminar premixed flames - Simplified analysis.

UNIT-3 TURBULENT FLOW

9

Factors influencing flame velocity and thickness flame stabilization – Diffusion flames – Introduction to turbulent flames.

UNIT-4 COMBUSTION OF SOLID FUELS

9

FBC – Different types of FBCs – Models for droplet and Carbon particle combustion.

UNIT-5 EMISSION CONTROL

9

Emissions - Emission index - Corrected concentrations - Control of emissions for premixed and non-premixed combustion.

Text book:

Turns, S.R., *An Introduction to Combustion - Concepts and Applications*, 3rd ed., McGraw-Hill, 2011.

References:

1. Sharma, S.P. and Mohan, c., *Fuels and Combustion*, Tata McGraw-Hill, 1984.

2. Sarkar.S., *Fuels and Combustion*, Orient Longman, 2009.

Total no of periods: 45

Course Code MME 103	Course Name: Advanced Fluid Mechanics		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES:						
The course is intended to						
• Establish an understanding of the fundamental concepts of fluid mechanics. • Understand and apply the potential flow equations to basic flows. • Understand and apply the differential equations of fluid mechanics including the ability to apply and understand the impact of assumptions made in the analysis. • Understand the boundary layer concepts with respect to fluid flow						
• Understand and apply the compressible flow equations						
COURSE OUTCOMES (COs)						
CO1	Ascertain basic concepts in the fluid mechanics					
CO2	Analyze practical problems of fluid flow					
CO3	Design compressible flow components used in Turbo machines and air- conditioning					
CO4	Understand the performance of fluid flow devices in laminar and Turbulent flows					
CO5	Apply the concepts in the analysis of fluid flow 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
2	CO1	H	H	M	H	H
	CO2	H	H	H	M	H
	CO3	M	H	M	M	H
	CO4	H	M	H	M	H
	CO5	M	M	M	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 REVIEW OF BASIC CONCEPTS

9

Review of Basic concepts- Reynolds's transport theorem, Fluid kinematics – Physical Conservation laws – Integral and differential formulations.

UNIT-2 FLOW ANALYSIS	9
Navier-Stokes and energy equations – Dimensionless forms and dimensionless numbers – Solution of Navier-Stokes equations.	
UNIT-3 LAMINAR FLOW	9
Two-dimensional Potential flows - Different types of flow patterns. Boundary layer theory - Blasius solution - Momentum integral approach.	
UNIT-4 TURBULENT FLOW	9
Turbulent flows– Reynolds equation –Prandtl and von Karman hypothesis- Universal velocity Profile near a wall- flow through pipes	
UNIT-5 BOUNDARY LAYER	9
Boundary layer concept- Boundary layer thickness- prandtl's equations-blasiuss solution-skin Friction coefficient.	

Text book:

Yunus.A.CENGAL., *fluid mechanics, 2nd edition.*, McGraw-Hill, 2010

References:

1. Currie, L.G., *Fundamental Mechanics of Fluids*, 4th ed., CRC Press, 2012.
2. White, P.M., *Viscous Fluid Flow*, 2nd ed., McGraw-Hill, 1991.
3. Ockendon, H. and Ockendon, J., *Viscous Flow*, Cambridge Uni. Press, 1995.

Total no of periods: 45

Course Code	Course Name: Advanced Heat Transfer	L	T	P	C
MME 105	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The course is intended to • Impart the advances knowledge of heat transfer. • Get analytical solutions for 2-D steady and transient heat conduction problems. • Deep understanding on the governing equations for convection heat transfer; knowing the dimensionless parameters (influencing the convection performance). • Aware of turbulence concept and modeling. • Apply the concept of natural convection for electronic cooling, HVAC etc.					
COURSE OUTCOMES (COs)					
CO1	Understand both the physics and the mathematical treatment of the advanced topics pertaining to the modes of heat transfer				
CO2	Apply principles of heat transfer to develop mathematical models for uniform and Non-uniform fins.				
CO3	Employ mathematical functions and heat conduction charts in tackling two- Dimensional and three-dimensional heat conduction problems				
CO4	Analyze free and forced convection problems involving complex geometries with proper boundary conditions				

CO5	Apply the concepts of radiation heat transfer for enclosure 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	M	H	-	H	
	CO2	H		-		L
	CO3	M	M	M	M	
	CO4	H		-		L
	CO5	M	H	-		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 TRANSIENT HEAT CONDUCTION

9

Transient heat conduction - Exact solution - Use of Heisler and Grober chart-Integrated method.

UNIT-2 STEADY STATE HEAT TRANSFER

9

Extended surfaces - Steady state analysis and optimization-Radial fins of rectangular and hyperbolic profiles- longitudinal fin of rectangular profile radiating to free space.

UNIT-3 CONVECTION

9

Thermal boundary layers - Momentum and energy equations -Internal and external flows- Forced convection over cylinders, spheres and bank of tubes.

UNIT-4 MASS TRANSFER

9

Heat transfer with phase change – condensation and boiling heat transfer- Heat transfer in condensation, Effect of non-condensable gases in condensing equipments. Flow boiling correlations.

UNIT-5 RADIATION

9

Radiative exchange in furnaces-Radiation characteristics of particle systems, Thermal radiation of a luminous fuel oil and gas- Soot flame- overall heat transfer in furnaces.

Text book:

Ozisik, M.N., *Heat Transfer- A Basic Approach*, McGraw-Hill, 2007.

References:

1. Incropera, P.P. and Dewitt, D.P., *Fundamentals of Heat and Mass Transfer*, 5th ed., John Wiley, 2002.
2. Kakac, S. and Yener, Y., *Convective Heat Transfer*, CRC Press, 1995.

3. Kraus, A.D., Aziz, A., and Welty, J., *Extended Surface Heat Transfer*, John Wiley, 2001.

Total no of periods: 45

Course Code MME 107	Course Name: Analysis of Thermal Power Cycles		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: The course is intended to • Provide analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to Introduce methods in using equations of potentials, availability, and exergy for thermodynamic analysis • Gain the knowledge on non-reactive mixture properties , Psychometric Mixture properties and psychometrics chart and Air conditioning processes • Develop the ability of analyzing vapor and Gas power cycles • Provide in depth knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy • Thermionic power generation ,Thermodynamic devices Magneto Hydrodynamic Generations and Photo voltaic cells • Develop communication and teamwork skills in the collaborative course project						
COURSE OUTCOMES (COs)						
CO1		Gain the analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to carry out the thermodynamic analysis using equations of potentials, availability, and exergy				
CO2		Apply the knowledge of adiabatic flame temperature in the design of combustion devices.				
CO3		Identify the phenomenon of flame stabilization in laminar and turbulent flames				
CO4		Analyze the pollution formation mechanisms in combustion of solid, liquid and gaseous fuels.				
CO5		Apply the knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy, Thermionic power generation ,Thermodynamic devices Magneto Hydrodynamic Generations and Photo voltaic cells				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	D	e
2	CO1	H	M	H	M	M
	CO2	M	H		H	
	CO3	H		M		M
	CO4	M	M	M	M	
	CO5	M		L		M

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

UNIT-1 VAPOUR POWER CYCLES 9

Steam power plant cycle – Rankin cycle – Reheat cycle – Regenerative cycle with one and more feed heaters – Types of feed heaters – Open and closed types – Steam traps types.

UNIT-2 COMBINED CYCLES 9

Cogeneration - Condensing turbines - Combined heat and power - Combined cycles - Brayton cycle Rankine cycle combinations - Binary vapour cycle.

UNIT-3 AIR STANDARD CYCLES 9

Air standard cycles – Cycles with variable specific heat – fuel air cycle – Deviation from actual cycle.

UNIT-4 AIR POWER CYCLES 9

Brayton cycle - Open cycle gas turbine - Closed cycle gas turbine - Regeneration - Inter cooling and reheating between stages.

UNIT-5 REFRIGERATION CYCLES 9

Refrigeration Cycles - Vapor compression cycles - Cascade system - Vapour absorption cycles - GAX Cycle.

Text book:

Nag, P.K., *Engineering Thermodynamics*, 3rd ed., Tata McGraw-Hill, 2005.

References:

1. Culp, R., *Principles of Energy Conversion*, McGraw-Hill, 2000.
2. Nag, P.K., *Power Plant Engineering*, 2nd Tata McGraw-Hill, 2002.
3. Arora, C.P., *Refrigeration and Air Conditioning*, 2nd ed., Tata McGraw-Hill, 2004.

Total no of periods: 45

Course Code MME 1L1	Course Name: Thermal Laboratory	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite:				

		Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The lab is mainly intended to - Analyze the performance and exhaust emissions of an IC engine by conducting the performance test on IC Engines. - Evaluate the performance of the Vapor compression and Air conditioning units - Analyze the flame propagation velocity of the gaseous fuels						
COURSE OUTCOMES (COs)						
CO1		Analyze the performance and exhaust emissions of an IC engine				
CO2		Evaluate the performance of the Vapor compression and Air conditioning units				
CO3		Analyze the flame propagation velocity of the gaseous fuels				
CO4		Analyze the pollution formation mechanisms in combustion of solid, liquid and gaseous fuels.				
CO5		Apply the knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy				
Mapping of Course Outcomes with 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	M	-	-	
	CO2	H	H	-	-	
	CO3	H		-	-	H
	CO4	H	M	M	-	
	CO5	H		-	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Total no of periods: 45

SEMESTER II

Course Code MME 202	Course Name: Fluid Mechanics of Turbo machines	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES: The course is intended to • Understand the fundamental concepts of turbo machines. • Apply concepts of fluid mechanics in turbo machines. • Understand the thermodynamic analysis of steam nozzles and turbines. • Understand the different types of compressors and evaluating their performances in the form of Velocity triangles. • Familiarize the basic concepts of gas dynamics and analyze the performance of axial flow gas Turbines.						
COURSE OUTCOMES (COs)						
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
2	CO1	M		M	M	H
	CO2	L	M			
	CO3				H	M
	CO4	M	L	H		
	CO5	M			M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 2D CASCADES

9

Introduction and cascades – Two-dimensional cascades – Analysis of cascade forces – Energy losses – Cascade correlation – Off design performance.

UNIT-2 POWER GENERATING MACHINES – TURBINES

9

Power generating machine I - Axial flow turbines- Stage losses and efficiency – Soderberg's correlation – Turbine flow characteristics

UNIT-3 POWER GENERATING MACHINES – COMPRESSORS

9

Course Code MME 204	Course Name: INSTRUMENTATION		L	T	P	C
	Total Contact Hours: 60		4	0	0	4
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: The course is intended to • Educate the student with operating principles and function of measuring instruments used in Engineering and process industries • Make the student conversant with various working principles of instruments • Understand and analyze the behavioral characteristics of instruments • Make the student learn about calibration procedure the instrument • Educate the student about the fundamental aspects of control; systems and their use in the context of industry applications						
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	M		L	-	
	CO2		L		-	
	CO3	M		L	-	M
	CO4		M		M	
	CO5	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	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 DISPLACEMENT 12

Generalized instrumentation system – Error theory – Calibration of instruments – Range – Resolution – Span – Linearity, Sensitivity- Signal conditioning systems.

UNIT-2 INSTRUMENTATION SYSTEM 12

Static and dynamic characteristics of instruments zero order, first order, second order instruments.

UNIT-3 ERROR ANALYSIS 12

Error analysis - Uncertainty propagation – Oscilloscope for analysis of dynamic and transient Events.

UNIT-4 MEASUREMENT SYSTEM 12

Principles and analysis of measurement systems used for measurement of flow, power, pressure, And temperature.

UNIT-5 CONTROL SYSTEM 12

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, 2007.

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.

Total no of periods: 60

Course Code MME 206	Course Name: COMPUTATIONAL FLUID DYNAMICS					L	T	P	C
	Total Contact Hours: 45					3	0	0	3
	Prerequisite:								
	Course Designed by : Department of Mechanical Engineering								
OBJECTIVES: The course is intended to • Understand the basics of computational fluid dynamics (CFD). • Differentiate between finite difference and finite volume methods applied in CFD. • Provide the necessary background in discretization methods, accuracy, stability and convergence aspects of numerical solutions. • Develop an understanding of the capabilities and limitations of various numerical and mathematical models of fluid flow. • Introduce some of the models required to compute turbulent and incompressible fluid flow problems									
• Apply CFD to heat transfer problems									
COURSE OUTCOMES (COs)									
CO1	Derive the basic governing equations applied for fluid flow problems								
CO2	Apply the differential equations to fluid flow problems								
CO3	Understand the concept of discretization.								
CO4	Solve simple algorithms for incompressible fluid flow								
CO5	Apply the basics of CFD to heat transfer 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			
2	CO1	H	M	-	H	M			
	CO2	H	H	-	H				
	CO3	M		-	H	H			
	CO4	H	M	M					
	CO5	M		-	M	H			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						

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

UNIT-1 CLASSIFICATION OF PDE & FDF 9

Classification of partial differential equations – Discretization methods – finite difference and finite volume formulations –classification of PDES.

UNIT-2 ELLIPTICAL EQUATIONS & LINEAR SYSTEMS 9

Numerical solution of elliptical equations – Linear system of algebraic equations – Iterative solution of system of linear equation.

UNIT-3 MODEL & WAVE EQUATION 9

Model Equations – Wave equations – Numerical solution of parabolic equations – Stability analysis– Advanced shock capturing schemes.

UNIT-4 CONVECTION HEAT TRANSFER 9

Solutions of convection - Diffusion equation – Conservative and non-conservative schemes – concept of artificial viscosity and Numerical Diffusion.

UNIT-5 NAVIER-STROKE EQUATION & GRID GENERATION 9

Navier-Stokes equations and algorithms; Basics of grid generation- Numerical solution of hyperbolic equations - Burgers equation generation.

Text book:

Hoffman, K.A. and Chiang, S.T., *Computational Fluid Dynamics for Engineers*, Engineering Education Systems, 2000.

References:

1. Tannehill, J.c., Anderson, D.A., and Pletcher, R.H., *Computational Fluid Mechanics and Heat Transfer*, 3rd ed., Taylor & Francis, 1997.
2. Peyret, R. and Taylor, T. D., *Computational Methods for Fluid Flow*, Springer- Verlag, 1983.

Total no of periods: 45

Course Code MME 208	Course Name: ADVANCED IC ENGINES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The course is intended to • Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle. • Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine’s performance. Understand the delay period and fuel injection system • Become aware of the relevance of environmental and social issues on the design process of internal combustion engines					

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	H	M	H
	CO2	M	M	H	H	
	CO3	H		H		M
	CO4	H	M	H	M	H
	CO5	H	H	H	M	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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 CHARACTERISTICS 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.

Total no of periods: 45

Course Code MME 2L1	Course Name: Heat Transfer Laboratory		L	T	P	C
	Total Contact Hours: 45		0	0	4	2
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: This course is designed to introduce a basic study of the phenomena of heat and mass transfer to develop methodologies for solving a wide variety of practical engineering problems, and provide useful information concerning the performance and design of particular systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail. As well, to gain experience in designing experiments for thermal systems, the design, fabrication, and experimentation of a thin film heat flux gage will be attempted as part of laboratory requirements.						
COURSE OUTCOMES (COs)						
CO1		Understand the basic laws of heat transfer and Account for the consequence of heat transfer in thermal analyses of engineering systems				
CO2		Analyze problems involving steady state heat conduction in simple geometries				
CO3		Obtain numerical solutions for conduction and radiation heat transfer problems and understand the fundamentals of convective heat transfer process.				
CO4		Evaluate heat transfer coefficients for natural convection, forced convection inside ducts, forced convection over exterior surfaces				
CO5		Analyze heat exchanger performance by using the method of log mean temperature difference.				
Mapping of Course Outcomes with 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		-		
	CO3	M		M		
	CO4	H		-		
	CO5	M	H	-		

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

LIST OF EXPERIMENTS

1. Thermal conductivity of insulating materials
2. Heat transfer through composite wall
3. Heat transfer from fins-natural and forced convection
4. Test on Pinfin apparatus
5. Heat balance test on twin cylinder 4 stroke diesel engine

Total no of periods: 45

SEMESTER III

Course Code	Course Name: ADVANCED REFRIGERATION AND AIR CONDITIONING	L	T	P	C
MME 302	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The course is intended to • Familiarize students with the terminologies associated with refrigeration & air conditioning • Cover the basic principles of psychometric and applied psychometrics • Familiarize students with system analysis • Familiarize students with load calculations and elementary duct design • Familiarize students with refrigerants; vapor compression refrigeration and multi-stage vapor compression systems • Understand the components of vapor compression systems and other types of cooling systems.					
COURSE OUTCOMES (COs)					
CO1	Understand physical and mathematical aspects of refrigeration and air- Conditioning systems and HVAC technology, engineering, research, systems, system designs, energy impacts, and overall goals				
CO2	Apply theoretical and mathematical principles to simple, complex vapor Compression				

	and vapor absorption refrigeration systems					
CO3	Understand conventional and alternate refrigerants and their impact on environmentand Develop understanding of the principles and practice of thermal comfort					
CO4	Review heat transfer and solar energy engineering and develop techniques for the analysis of building envelope loads					
CO5	Design air-conditioning systemsand Develop generalized psychometrics’ of moist air an apply to HVAC 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
2	CO1			M		M
	CO2	M	M		H	
	CO3	H		H		M
	CO4	H	M	H	M	H
	CO5	H	L	M	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 VAPOUR COMPRESSION SYSTEM 9

Actual vapor compression system – Multipressure vapour compression system – Environment Friendly refrigerants – cascade system.

UNIT-2 VAPOUR ABSORPTION SYSTEM 9

Absorption refrigeration system – Three fluid absorption system – comparison of absorption with Compression system - Analysis of multistage systems

UNIT-3 PSYCHROMETRY & COOLING LOAD CALCULATIONS 9

Advanced psychrometric calculations - Cooling load calculations – Determination of U factor – Short method calculation

UNIT-4 CRYOGENICS 9

Low temperature refrigeration – Joule Thompson coefficient – liquefaction of air – hydrogen – Helium – Applications of cryogenics.

UNIT-5 DUCTS 9

Room air distribution – Friction losses in ducts - Duct design, Air filters clean rooms – Air Curtain

Text book:

Arora, c.P., *Refrigeration and Air Conditioning*, 2nd ed., Tata McGraw-Hill, 2004.

References:

1. Stoeker, W.P. and Jones, J.W., *Refrigeration and Air Conditioning*, 2nd ed., Tata McGraw-Hill, 1982.
2. Manohar Prasad, *Refrigeration and Air Conditioning*, New Age International, 1996.
3. Gosney, W.B., *Principles of Refrigeration*, Cambridge Uni. Press, 1982.

Total no of periods: 45

Course Code MME 304	Course Name: ENVIRONMENTAL POLLUTION AND CONTROL		L	T	P	C
	Total Contact Hours: 45		3	0	0	3
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: The course is intended to • Learn the principles of air and water pollution, effect of these pollutants on the environment and the methods available to control them. • Familiar with technical and scientific methods for treating, controlling or safely disposing of air and water emissions, which could pose a threat to the environment						
COURSE OUTCOMES (COs)						
CO1		Design of mechanical systems and interdisciplinary engineering applications and business solutions using suitable optimization technique				
CO2		Apply numerical or iterative techniques in power systems for optimal power flow solutions				
CO3		Optimize the parameters in control systems for desired steady state or transient response				
CO4		Optimize the cost function in deciding economic factors of power systems				
CO5		Design of electrical systems optimally using suitable techniques like un variety method, steepest descent method etc				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	M			-	L
	CO2		M	H	-	L
	CO3	M			M	M
	CO4			H	M	M
	CO5	H	M	M	L	-

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

UNIT-1 AIR POLLUTION 9

Air pollution – Classification and properties of Air pollutants – Sampling and analysis of air pollutants –Control of air pollution.

UNIT-2 AIR POLLUTION MODEL & CONTROL 9

Dispersion of air pollutants - Gaussian plume model- Control of gaseous pollutants - Volatile organic compounds - Control of gaseous emission - Air pollution laws and standards.

UNIT-3 WATER POLLUTION 9

Water pollution - Sampling and analysis of waste treatment – Advanced waste water treatments by physical, chemical, biological and thermal methods - Effluent quality standards.

UNIT-4 WASTE MANAGEMENT 9

Solid waste management - Classification and their sources - Health hazards - Handling of toxic and radioactive wastes - Incineration and verification.

UNIT-5 APPLICATION OF POLLUTION CONTROL METHODS 9

Pollution control in process industries namely Cement, Paper, Petroleum and petrochemical, Fertilizers and distilleries, thermal power plants and automobiles.

References:

1. Manster, G.M., *Introduction to Engineering and Science*, 2nd ed., Pearson Publishers, 2004.
2. Rao, E.S., *Environmental Pollution Control Engineering*, Wiley Eastern Ltd., 1991.
3. Mahajan, S.P., *Pollution Control in Process Industries*, Tata McGraw-Hill, 1985.
4. Crawford, M., *Air Pollution Control Theory*, TMH, 1976.

Total no of periods: 45

ELECTIVES

Course Code	Course Name: ANALYSIS AND DESIGN OF PRESSURE VESSELS	L	T	P	C

MMD 203		Total Contact Hours: 45				3	0	0	3
		Prerequisite:							
		Course Designed by : Department of Mechanical Engineering							
OBJECTIVES:									
To understand the different types of stresses and their effects in pressure vessel									
To understand the piping layout and the stresses acting on it.									
COURSE OUTCOMES (COs)									
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			
2	CO1	L				H			
	CO2		H						
	√								
	CO4								
	CO5								
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT-1 DESIGN CONDITION FOR PRESSURE VESSELS

9

Establishment of design conditions – Fracture Mechanics – Heads, Basic shell thickness - Reinforcement of openings – Special components like flange, tube plate, supports.

UNIT-2 THICK CYLINDERS

9

Cylindrical shells – Thick cylinders- Lamé's solution - Theories of breakdown of elastic action – Unrestrained solution – Lateral loading – General loading. Axisymmetric loading - Membrane solutions - Edge bending solutions - Flexibility matrix.

UNIT-3 GENERAL ANALYSIS

9

Application of general analysis – Flat closure plates – conical heads and reducers – hemispherical and torispherical, ellipsoidal heads.

UNIT-4 FAILURE MODES

9

Development of cracks - Fracture mechanics - Corrosion - Selection of working stress for ductile and brittle materials.

UNIT-5 FEA IN PRESSURE VESSELS

9

Finite element analysis for high pressure and high temperature components.

Text book:

1. Bickell, M.B. and Ruiz, c., *Pressure Vessel Design and Analysis*, MacMillan, London, 1967.

References:

1. Den Hartog, J.P., *Advanced Strength of Materials*, McGraw-Hill, 1949.
2. Timoshenko, S., *Strength of Materials*, Van Nostrand, 1986.

Total no of periods: 45

Course Code MME E2	Course Name: ENERGY CONSERVATION, MANAGEMENT, AND AUDIT	L	T	P	C	
	Total Contact Hours:	3	0	0	3	
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: Demonstrate the importance and role of energy management in the functional areas Manufacturing Industry, Process Industry,. Commerce and Government Enable the students to understand the basic energy conversion and management principles and to identify sources of energy loss and target savings Enable students in carrying out budgeting and risk analysis Analyze the performance of the wind turbine						
COURSE OUTCOMES (COs)						
CO1	Explain the fundamentals of energy management and its influence on environment and to Develop the concepts of energy management which is essential in the functional areas like Manufacturing Industry, Process Industry,. Commerce and Government					
CO2	Understand the basic energy conversion and management principles and to identify sources of energy loss and target savings andDescribe methods of energy production for improved utilization					
CO3	Carry out budgeting and risk analysisandApply the principles of thermal engineering and energy management to improve the performance of thermal systems					
CO4	Analyze the performance of the wind turbineAssess energy projects on the basis of economic and financial criteria					
CO5	Apply the principles of thermal engineering and energy management to improve the performance of thermal 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	M			-	L

	CO2		M	H	-	L
	CO3	M			M	M
	CO4			H	M	M
	CO5	H	M	M	L	-
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 BASICS OF ENERGY

9

Energy Scenario - Basics of Energy and its various forms - Energy Management and -Audit - Material and Energy Balance -Energy Action Planning-Financial Management -Project Management -Energy Monitoring and Targeting -Global Environmental Concerns

UNIT-2 COMBUSTION OF FUELS & BOILERS

9

Energy Efficiency in Thermal Utilities – Fuels and Combustion-Boilers-Steam System-Furnaces –Insulation and Refractory –FBC Boilers –Cogeneration –Waste heat recovery

UNIT-3 ELECTRICAL SYSTEMS

9

Energy Efficiency in Electrical Utilities-Electrical Systems-Electric Motors-Compressed Air System-HVAC and Refrigeration System-Fans and Blowers-Pumps and Pumping System-Cooling Tower-Lighting System-Diesel Generating System-Energy Efficient Technologies in Electrical Systems

UNIT-4 ENERGY AUXILIARY

9

Energy Performance Assessment for Equipment and Utility systems -Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-Electric Motors and Variable Speed

UNIT-5 RENEWABLE ENERGY SOURCES & WASTE MINIMIZATION

9

Drives-Fans and Blowers-Water Pumps-Compressors
HVAC Systems-Lighting Systems-Performing Financial Analysis-Applications of Non-Conventional and Renewable Energy Sources-Waste Minimization and Resource Conservation

Text book:

Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of energy efficiencies, 2005.

Total no of periods: 45

Course Code MME E5	Course Name: BOILER AUXILIARIES AND PERFORMANCE EVALUATION					L	T	P	C
	Total Contact Hours:					3	0	0	3
	Prerequisite:								
	Course Designed by : Department of Mechanical Engineering								
OBJECTIVES									
COURSE OUTCOMES (COs)									
CO1									
CO2									
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								
	CO2								
	CO3								
	CO4								
	CO5								
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

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 electro static 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.

Total no of periods: 45

Course Code MTE E6	Course Name: HEAT TRANSFER EQUIPMENT DESIGN	L	T	P	C	
	Total Contact Hours:	3	0	0	3	
	Prerequisite:					
	Course Designed by :					
OBJECTIVES: The course is intended to • Design and analyses the heat exchangers parallel flow, counter flow, multipass and, cross flow heat exchanger • Design and analyze the Shell and tube heat exchanger • Enable to carry out the performance of heat exchanger with the extended surfaces. • Design and analyses the cooling towers.						
COURSE OUTCOMES (COs)						
CO1	Design and analyze the parallel flow, counter flow, multi-pass and, cross flow heat exchangers					
CO2	Develop the Shell and tube heat exchanger					
CO3	Optimize the performance of heat exchanger					
CO4	Design and analyze the cooling towers					
CO5	Apply the concepts of radiation heat transfer for enclosure 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	M	-	M	H
	CO2	H	M	-	M	M
	CO3	H	M	-	M	M

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

UNIT-1 INTRODUCTION 9

Classification of heat transfer equipment – Design of shell and tube heat exchanger – Finned Surface heat exchanger –Heat exchangers for special services – Fired heaters

UNIT-2 HEAT EXCHANGER & HEAT PIPES 9

Plate and spiral plate heat exchanger – plate heat exchanger for Dairy industry – Heat Pipes

UNIT-3 DESIGN OF AUXILIARY SYSTEMS 9

Thermal design of heat exchange equipments such as Air pre-heaters , Economizer – Super heater and condensers.

UNIT-4 HEAT EXCHANGER SELECTION 9

Selection of compact heat exchangers.

UNIT-5 COOLING TOWERS DESIGN AND ANALYSIS 9

Analysis and design of cooling towers.

Text book:

Ganapathy, v., *Applied Heat Transfer*, Pennwell Books, 1982.

References:

1. Kays, W.M. and London, A.L., *Compact Heat Exchangers*, McGraw-Hill, 1998.
2. Dunn, P. and Reay, D.A., *Heat Pipes*, Pergamon, 1994.
3. Kakac, S. and Liu, H., *Heat Exchangers*, CRC Press

Total no of periods: 45

Course	Course Name: INSTALLATION, TESTING, AND	L	T	P	C

Code MME E7	OPERATION OF BOILERS								
	Total Contact Hours:					3	0	0	3
	Prerequisite:								
	Course Designed by : Department of Mechanical Engineering								
OBJECTIVES: To impart knowledge regarding insulation of boilers, ducts and dampers, insulation of boilers, boiler commissioning testing inspection and cleaning of boilers.									
COURSE OUTCOMES (COs)									
CO1	Can install boilers with all safety measures								
CO2	Can provide insulation of boilers								
CO3	Can commission a boiler								
CO4	Can estimate life of very old boilers								
CO5	Can do performance test on boilers.								
Mapping of Course Outcomes with 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	M	-	M	H			
	CO2	H	M	-	M	M			
	CO3	H	M	-	M	M			
	CO4	H	L	-	M	H			
	CO5	H	M	-	L	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT-1 INSTALLATION OF BOILERS

9

Installation of boilers – Supporting structures, Sequence of Erection, HSFC Bolts – Drum lifting alignment - Provision for expansion of water walls

UNIT-2 DUCTS & DAMPERS

9

Erection of Ducts - ESP - APH - and fans- Alignment. Erection of ducts and dampers – Cold pull.

UNIT-3 INSULATION OF BOILERS

9

Lining and Insulation – Material characteristics and selection - Procedure for mounting Gaskets for erection of boilers.

UNIT-4 BOILER COMMISSIONING**9**

Boiler commissioning activities – Drying out –Boiling out – Chemical cleaning initial operation
– Abnormal operations – precautions –shutting down

UNIT-5 TESTING,INSPECTION& CLEANING**9**

Codes for Testing, Inspection and cleaning – Boiler pressure parts – Life estimation for very old boilers – Thermal performance test and capacity restoration.

References:

1. *Erection of Boilers and Auxiliary Equipment*, Manuals Prepared by B.H.E.L., Tiruchirappalli, 1990.

Total no of periods: 45

Course Code MME E9	Course Name: NON DESTRUCTIVE TESTING AND FAILURE ANALYSIS	L	T	P	C	
	Total Contact Hours:	3	0	0	3	
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: 1. To understand the principles behind various NDT techniques 2. To study about NDT equipments and accessories 3. To learn working procedures of various NDT techniques						
COURSE OUTCOMES (COs)						
CO1	Demonstrate good grounding in the area of NDT					
CO2	To select proper NDT Method for his application					
CO3	Understand the utilization of test and measurement appropriate to the area of his study/problem					
CO4	Comparison and selection of different NDT methods					
CO5	design and material Improvements derived from 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
2	CO1	M	M	-	M	H
	CO2	M	M	-	M	M
	CO3	M	M	-	M	M
	CO4	M	L	-	M	H
	CO5	M	M	-	L	M

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

UNIT-1

NDT V/s destructive testing – advantages and limitations – different types of NDT

UNIT-2

9

Detailed discussion of LPT, MPT and radiography

UNIT-3

9

Eddy current and ultrasonic techniques

UNIT-4

9

Comparison and selection of different NDT methods – statistical significance – reliability aspects – Need for multiple NDT procedures in critical components – concept of NDE

UNIT-5

9

Concept of failure analysis – methodology, approaches and tools – design and material Improvements derived from case studies – fracture mechanics approach

References:

1. Baldev Raj, Jayakumar, Thavasimuthu. M., *Practical Non destructive testing*, Narosa Publishing, 1997.
2. Das. A.K., *Metallurgy of failure analysis*, Tata McGraw Hill, 1992.

Total no of periods: 45

Course Code MME E10	Course Name: FRONTIER MATERIALS	L	T	P	C
	Total Contact Hours:	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: To impart knowledge regarding various types of smart materials and steels					
COURSE OUTCOMES (COs)					
CO1	Understand the mechanical behavior such as tensile, fatigue and creep of ductile				

		and brittle materials				
CO2	Analyze Failure of various components					
CO3	Understand Materials characterization techniques					
CO4	Analyze different types of steels					
CO5	Analyze different types of smart material like shape memory alloys					
Mapping of Course Outcomes with 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	M	M	-	M	H
	CO2	M	M	-	M	M
	CO3	M	M	-	M	M
	CO4	M	L	-	M	H
	CO5	M	M	-	L	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-1 INTRODUCTION

9

Trends and developments in materials – historical perspective – challenging applications

UNIT-2 TOP DOWN – BOTTOM DOWN APPROACHES

9

Need for microstructurally engineering materials – top down and bottom up approaches in Assemblage of materials / particles

UNIT-3 METALLIC GLASSES

9

Detailed discussion on specific material systems – metallic glasses – processing conditions – bulk metallic glasses

UNIT-4 STEELS & ALLOYS OF STEELS

9

Stainless steel and special steels – low-density high strength alloys – super alloys – cryogenic Materials

UNIT-5 SMG, FGM

Shape memory alloys – FGM's – biomaterials – nano materials

Text book:

Leslie. V. C., *Physical Metallurgy of steels*, McGraw Hill, 1982.

References:

Polmear. I. J., *Light Alloys, Metallurgy of Light Metals*. 3rd edition, Arnold 1995.

Total no of periods: 45

Course Code MME E11	Course Name: COMBUSTION ENGINEERING		L	T	P	C
	Total Contact Hours:		3	0	0	3
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: To impart knowledge regarding nature and mechanism of combustion phenomena and relate combustion with engine performance						
COURSE OUTCOMES (COs)						
CO1	Apply thermodynamic analysis to IC engines and describe combustion phenomena. In spark ignition and compression ignition engines					
CO2	Describe the working of major systems used in conventional and modern engines					
CO3	Summarize the methods used to improve engine performance and estimate Performance parameters					
CO4	Describe engine emission control techniques and implement viable alternate fuels					
CO5	Describe Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion 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	M	-	H	-	-
	CO2	H	H	H	H	H
	CO3	L	H	H	H	L
	CO4	-	-	H	H	H
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CHEMICAL REACTIONS

Fuels and combustion, Theoretical and actual combustion processes, Enthalpy of formation and enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature, Entropy change of reacting systems, Second law analysis of reacting systems, problems

UNIT II COMBUSTION OF GASEOUS AND VAPORIZED FUELS 9

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation

UNIT III COMBUSTION OF LIQUID FUELS 9

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays

UNIT IV COMBUSTION OF SOLID FUELS 9

Drying of solid fuels, devolatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

UNIT V FLUIDIZED BED COMBUSTION 9

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, are circulating fluidized beds, pressurized fluidized bed combustion, problems.

References:

1. Gary.L.Borman, *Combustion Engineering-McGraw Hill international Edition,1998*
2. Roger.A.Strehlow-*Combustion fundamentals- McGraw Hill international Edition,1989*
3. Yunus.A.Cengel-*Thermodynamics-International edition,2006*

TOTAL NO. OF PERIODS: 45

Course Code MME E13	Course Name: NEW AND RENEWABLE SOURCES OF ENERGY	L	T	P	C
	Total Contact Hours:	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				
OBJECTIVES: The course is intended to • Provide a fundamental treatment of fluid flows controlled by viscous or turbulent stress gradients and the subsequent heat transfer between fluids and solid surfaces. • Provide analytical solutions to the momentum and energy conservation equations for both laminar and turbulent flows will be considered. • Provide solid foundation for the engineering practitioner engaged in single phase convective thermal transport. • Provide solid foundation for further studies in multiphase convective transport.					
COURSE OUTCOMES (COs)					
CO1	Identify the renewable energy sources and their utilization				
CO2	Understand the basic concepts of the solar radiation and analyze the solar				

	Thermal systems for their utilization					
CO3	Understand the principle of working of solar cells and their modern Manufacturing					
CO4	Understand the concepts of the ocean thermal energy conversion systems and their applications					
CO5	Outline the methods of energy storage and identify the appropriate methods of Energy stor for specific 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	M	M	M	M	M
	CO2	M	H	M	M	H
	CO3	M	H	M	M	L
	CO4	M	H	L	M	L
	CO5	M	H	M	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I WIND ENERGY 9

Introduction-Location of Wind Generators-Types of Windmills-Induction and Synchronous Systems

UNIT II SOLAR ENERGY 9

Principle of Conversion of Solar Radiation into Heat, Types of Solar Thermal Collectors- Flat Plate and Concentrating Collectors (Parabolic, Trough, Minor Strip, Fresnel Lens and Compound Parabolic Concentrator), Comparison of Collectors, Selective Absorber Coatings, Solar Thermal Power Plant

UNIT III SOLAR ENERGY STORAGE AND APPLICATION 9

Solar energy storage systems- thermal, electrical, chemical, mechanical and electromagnetic, solar pond.Application of solar energy- solar thermoelectric conversion- solar photo voltaics, solar heating and cooling of buildings, solar distillation, solar pumping and solar cookers. System of solar cell power plant- direct grid connection through electronic control devices

UNIT IV BIO- MASS 9

Sources Of Bio-Mass Energy- Wood And Agricultural Waste- Municipal Waste- Animal Waste- Energy Conservation Systems- Biogas Generation From Animal Waste- Wood Gasification- Downdraft And Fluidized Bed Systems- Alcohol Fuels

UNIT V OTHERSOURCES**9**

Wave Energy- Scope and Simple Systems for Power Generation, Tidal Power- Scope and Applications, Otec-Scope, Fundamental Principles and Operating System for Power Generation

References:

1. David M.Eggleston and Forrest S.Stoddard, Wind Turbine Engineering Designing- Van Nostrand 1987
2. Rai, G.D. Non – Conventional Sources of Energy, Khanna publications, 4th edition 2004
3. Le Gouries, D, Wind Power Plants, Theory and Design –permagon press, 1982.
4. F.S.seiler, Alternate Energy Vehicle Information, Wind Book Inc., 1977
5. Barbara Keiler, Energy Alternatives, Luscentr Books, 1990
6. T.NejatVeziroygal, Alternative Energy Sources-III, Hemisphre Publishing co., 1989.

TOTAL NO OF PERIODS-45

Course Code MME E133	Course Name: NUCLEARENGINEERING	L	T	P	C	
	Total Contact Hours:	3	0	0	3	
	Prerequisite:					
	Course Designed by : Department of Mechanical Engineering					
OBJECTIVES: To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.						
COURSE OUTCOMES (COs)						
CO1	Will understand the principal of nuclear physics					
CO2	Will understand about nuclear reactions and nuclear reaction materials					
CO3	Will understand the nuclear fuel cycles					
CO4	Will understand the nuclear reactor					
CO5	Will understand the safety and disposal					
Mapping of Course Outcomes with 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				
	CO2		L			
	CO3			M		
	CO4				H	
	CO5					L

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

UNIT I NUCLEAR PHYSICS

9

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

UNIT II NUCLEAR REACTIONS AND REACTION MATERIALS

9

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

UNIT III REPROCESSING

9

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

UNIT IV NUCLEAR REACTOR

9

Nuclear reactors: types of fast breeding reactors-design and construction of fastbreeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

UNIT V SAFETY AND DISPOSAL

9

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley 1978.90

REFERENCES:

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York. 1987

2. Wakil M.M.El., “Power Plant Technology” – McGraw-Hill International, 1984.

Course Code EY7202	Course Name: DESIGN AND ANALYSIS OF TURBOMACHINES			L	T	P	C
	Total Contact Hours:			3	0	0	3
	Prerequisite:						
	Course Designed by : Department of Mechanical Engineering						
OBJECTIVES:							
1. To understand the energy transfer process in Turbo machines and governing equations of various forms.							
2. To understand the structural and functional aspects of major components of Turbo machines.							
3. To design various Turbo machines for power plant and aircraft applications							
COURSE OUTCOMES (COs)							
CO1							
CO2							
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						
	CO2						
	CO3						
	CO4						
	CO5						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT I INTRODUCTION

12

Basics of isentropic flow – static and stagnation properties – diffuser and nozzle configurations - area ratio – mass flow rate – critical properties. Energy transfer between fluid and rotor velocity triangles for generalized turbo machines - velocity diagrams. Euler's equation for turbo machines and its different forms. Degree of reaction in turbo-machines – various efficiencies – isentropic, mechanical, thermal, Overall and polytropic

UNIT II CENTRIFUGAL AND AXIAL FLOW COMPRESSORS

9

Centrifugal compressor - configuration and working – slip factor - work input factor – ideal and actual work - pressure coefficient - pressure ratio. Axial flow compressor – geometry and working – velocity diagrams – ideal and actual work – stage pressure ratio - free vortex theory – performance curves and losses

UNIT III COMBUSTION CHAMBER

6

Basics of combustion. Structure and working of combustion chamber – combustion chamber Arrangements - flame stability – fuel injection nozzles. Flame stabilization - cooling of combustion chamber

UNIT IV AXIAL AND RADIAL FLOW TURBINES

9

Elementary theory of axial flow turbines - stage parameters- multi-staging - stage loading and flow coefficients. Degree of reaction - stage temperature and pressure ratios – single and twin spool arrangements – performance. Matching of components. Blade Cooling. Radial flow turbines.

UNIT V GAS TURBINE AND JET ENGINE CYCLES

9

Gas turbine cycle analysis – simple and actual. Reheated, Regenerative and Intercooled cycles for power plants. Working of Turbojet, Turbofan, Turboprop, Ramjet, Scramjet and Pulsejet Engines and cycle analysis – thrust, specific impulse, specific fuel consumption, thermal and propulsive efficiencies.

TOTAL: 45 PERIODS

Course Code TE7011	Course Name: ADVANCED THERMAL STORAGE TECHNOLOGIES L T P C					L	T	P	C
	Total Contact Hours:					3	0	0	3
	Prerequisite:								
	Course Designed by : Department of Mechanical Engineering								
OBJECTIVES:									
1. To learn the various types of thermal storage systems and the storage materials									
2.To develop the ability to model and analyze the sensible and latent heat storage units									
3. To study the various applications of thermal storage systems									
COURSE OUTCOMES (COs)									
CO1									
CO2									
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								
	CO2								
	CO3								
	CO4								
	CO5								

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

UNIT I INTRODUCTION 8

Necessity of thermal storage – types-energy storage devices – comparison of energy storage Technologies - seasonal thermal energy storage - storage materials.

UNIT II SENSIBLE HEAT STORAGE SYSTEM 9

Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storagesystem – use of TRNSYS – pressurized water storage system for power plant applications – packedbeds.

UNIT III REGENERATORS 10

Parallel flow and counter flow regenerators – finite conductivity model – non – linear model – transientperformance – step changes in inlet gas temperature – step changes in gas flow rate – parameterization of transient response – heat storage exchangers.

UNIT IV LATENT HEAT STORAGE SYSTEMS 9

Modeling of phase change problems – temperature based model - enthalpy model - porous mediumapproach - conduction dominated phase change – convection dominated phase change.

UNIT V APPLICATIONS 9

Specific areas of application of energy storage – food preservation – waste heat recovery – solar energy storage – green house heating – power plant applications – drying and heating for process industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.

REFERENCES:

- Schmidt.F.W and Willmott.A.J, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.
- Lunardini.V.J, Heat Transfer in Cold Climates, John Wiley and Sons 1981

RESEARCH METHODOLOGY

Course Code	Course Name: RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours:	3	0	0	3

MST070		Prerequisite:				
		Course Designed by :				
OBJECTIVES:						
• To Get adequate knowledge about research concepts • To describe mathematical modeling and simulation • To understand experimental modeling • To get knowledge about the interpretation of result						
COURSE OUTCOMES (COs)						
CO1		To describe research concepts				
CO2		To Get adequate knowledge about mathematical modeling				
CO3		To describe experimental modeling				
CO4		To understand analysis of results				
CO5		To know about report writing				
Mapping of Course Outcomes with 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	S	M			
	CO2	S	M			
	CO3	S	M			
	CO4	S	M			
	CO5	S	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. RESEARCH CONCEPTS

9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION

9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING

9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS

9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING

9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis“, Himalaya Publication.
2. SchankFr., „Theories of Engineering Experiments“, Tata McGraw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, “Design of Experiments“, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, “Statistical Quality Control: An Introduction for Management“, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design“, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education“, PHI Publication.
5. Adler and Granovsky, “Optimization of Engineering Experiments“, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application“, Wiley Eastern Ltd., New Delhi, 1996.