University of Pune

COURSE STRUCTURE FOR M.E. (E & TC) (Microwave)
(w. e. f. June – 2013)

SEMESTER I

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./Pr	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
504301	Electromagnetics and Antenna Theory	4	50	50	-	-	100	4
504302	RF and Microwave Circuits	4	50	50	-	-	100	4
504303	Microwave Measurements	4	50	50	-	-	100	4
504104	Research Methodology	4	50	50	-	-	100	4
504305	Elective I	5	50	50	-	-	100	5
504306	Lab Practice I	4	-	-	50	50	100	4
Total		25	250	250	50	50	600	25

SEMESTER II

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pr	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
504307	Computational Electromagnetics	4	50	50	-	-	100	4
504308	RF and MMIC Technology	4	50	50	-	-	100	4
504309	Wireless Communication System	4	50	50	-	-	100	4
504310	Elective II	5	50	50	-	-	100	5
504311	Lab Practice II	4	-	-	50	50	100	4
504312	Seminar I	4	-	-	50	50	100	4
Total		25	200	200	100	100	600	25

SEMESTER III

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pr	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
604301	EMI and EMC Techniques	4	50	50	-	-	100	4
604302	Radar and Satellite Communications	4	50	50	-	-	100	4
604103	Elective III	5	50	50	-	-	100	5
604304	Seminar II	4	-	-	50	50	100	4
604305	Project Stage I	08	-	-	50	50	100	8
Total		25	150	150	100	100	500	25

SEMESTER IV

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME				CREDITS
		Lect./ Pr	Paper	TW	Oral/ Presentation	Total	
604306	Seminar III	5	-	50	50	100	5
604307	Project Work Stage II	20	-	150	50	200	20
Total		25	-	200	100	300	25

Elective I	1. Signal Processing for Wireless Communications 2. Communication Network 3. Fiber Optic Communication 4. Mathematics for Microwave Engineering 5. *LATEX
Elective II	1. Micro Strip Antennas 2. Smart Antennas 3. Cognitive Radio 4. Wave Propagation and Models 5. *Software Tools
Elective- III	1.Value Education, Human Rights and Legislative Procedures 2. Environmental Studies 3. Energy Studies 4. Disaster Management 5. Knowledge Management 6. Foreign Language 7. Economics for Engineers

	8. Engineering Risk – Benefit Analysis 9. Technology Play 10. Optimization Techniques 11. Fuzzy Mathematics 12. Design and Analysis of Algorithms 13. CUDA

Note: Syllabus for Elective III is common for all discipline.

504301	Electromagnetics and Antenna Theory	
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Review Electromagnetic Field Theory: Maxwell's Equations, Boundary conditions, Wave Equation. Plane waves in lossless and lossy media. Reflection and Refraction, Vector Potentials A and F, Electric and Magnetic current sources M, J, Uniqueness theorem, Field Equivalence Principle: Huygens Principle.

Module II

Wire Antennas: Antenna parameters, Linear Antennas, Infinitesimal dipole, small dipole, finite and half wave dipole, loop antenna.

Antenna Arrays: Two element array, N-element array Uniform spacing and uniform non uniform amplitude, binomial array, Dolph -Tschebyscheff's Array, planar and circular array..

Module III

Aperture Antennas: Circular Apertures, Rectangular Aperture, Horn Antenna: E-plane, H-Plane pyramidal and conical horn antenna, Reflector Antennas: Plane Reflector, Corner reflector and Parabolic Reflector.

Module IV

Travelling Wave Antennas: Long wire, V Antenna, Rhombic Antenna, Broad band Antennas: Helical Antenna, Yagi-Uda of Linear elements, Yagi - Uda Array of Loops, Spiral Antennas, Log-Periodic Antenna.

Microstrip Antennas: Basic Characteristics, feeding methods, methods of analysis, rectangular patch, circular patch, quality factor, bandwidth efficiency, input impedance, circular polarization, arrays and feed networks.

References:

1. Constantine A Balanis, Antenna Theory; Analysis and Design, John Wiley & Sons, Inc, 2007
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, Tata McGraw-Hill Publishing Company Limited, 2002
3. R.C.Johnson and H.Jasik,Antenna Engineering hand book, Mc-Graw Hill,1984
4. I.J.Bhal and P.Bhartia,Micro-strip antennas,Artech house,1980

Electromagnetics and Antenna Theory

Laboratory Assignments/Experiments:

1. Write MATLAB program to simulate the radiation pattern of the following antennas
   i. Hertzian Dipole
   ii. Finite Length Dipole
   iii. Half Wave Dipole
2. Carry out the Far Field Measurements and Plot the Radiation pattern and find the directivity, gain, effective length for the Half wave dipole
3. Carry out the Far Field Measurements and Plot the Radiation pattern and find the directivity, gain, effective length for the Helix Antenna
4. Write Program for Antenna arrays to plot the radiation pattern for End-Fire, Broadside, Binomial, Tschebyshev's

504302	RF and Microwave Circuits	
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Transmission Line Theory

Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Microwave Network Analysis

Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Module II

Microwave Components

Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Nonlinearity And Time Variance

Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Module III

Microwave Semiconductor Devices And Modelling

PIN diode, Tunnel diodes, varactor diode, schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Module IV

Amplifiers Design

Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise , high power and broadband amplifier, oscillators, Mixers design.

References:

1. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Pr entice Hall 1987.
2. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc.
3. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
4. D.M.Pozar' Microwave engineering' ,Wiley, 3rd edition.

RF and Microwave Circuits

Laboratory Assignments/Experiments:

1. Calculate the standing wave ratio and plot the pattern along a slotted line when it is open circuited, short circuited and terminated with matched load.
2. Find the scattering matrix for E, H and E-H planes.
3. Study the operation of ferrite circulator and measure isolation, insertion loss and cross coupling.
4. Design RF transmitter and receiver.
5. Model any one of known RF components.

504303	Microwave Measurements	
Teaching Scheme: **Lectures 4Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Transmission Lines, Scattering Parameters

Transmission Lines - Basic principles, Structures and Properties of Transmission Lines, lossless wave guides. Scattering Parameters and Circuit Analysis, Uncertainty and Confidence in measurements, Using Coaxial Connectors in Measurement.

Module II

Attenuation Measurement

Basic principles, Measurement systems, important considerations when making attenuation measurements.

RF Voltage Measurement

RF voltage measuring instruments, impedance matching and mismatch errors.

Noise Measurements

Types of noise, types of noise source, measuring noise, measurement accuracy, mismatch effects, automated noise measurements.

Module III

Network Analyzers and Spectrum Analyzer

Measurements and Applications, Elements of network analyzer, MMIC measurement techniques, calibration and verification of automatic network analyzers, spectrum analyzer basic principle, applications of spectrum analyzer.

Module IV

RF Power Measurement

Power sensors, power measurements and calibration, calibration and transfer standards, power splitters, couplers and reflectometers.

References:

1. Richard Collier & Douglas Skinner, Microwave Measurements, 3rd Edition, IET, 2007
2. Ginzton, EL, Microwave Measurements, McGraw Hill-1957

Microwave Measurements

Laboratory Assignments/Experiments:

1. Measure the spectrum of various fundamental signals, harmonics and AM, FM, BPSK modulated signals.
2. Study the Network Analyzer, Carry out the measurements of s-parameter measurement for the various microstrip components.
3. Carry out the attenuation measurement.
4. Carry out the RF Noise measurements.
5. Explain in detail the concept of RF power measurement. Carry out the RF power measurement using microwave bench.

Write a detailed assignment on uncertainty analysis in various measurements.

504104	Research Methodology	

Teaching Scheme: Lectures 4Hrs/ Week		Examination Scheme: Theory : 50 Marks (In Semester) 50 Marks (End Semester) Credits : 4

Module I

Research Problem

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Module II

Basic instrumentation

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Applied statistics

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis.

Module III

Modelling and prediction of performance

Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Module IV

Developing a Research Proposal

Format of research proposal, Individual research proposal, Institutional proposal

Proposal of a student– a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research.

References:

1. Research methodology: an introduction for science & engineering students, by Stuart Melville and Wayne Goddard
2. Research Methodology: An Introduction by Wayne Goddard and Stuart Melville

3. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar, 2nd Edition
4. Research Methodology: Methods and Trends, by Dr. C. R. Kothari
5. Operational Research, by Dr. S.D. Sharma, Kedar Nath Ram Nath & co.

Research Methodology

Laboratory Assignments/Experiments:

1. Design a typical research problem using scientific method
2. Design a data collection system using digital computer system.
3. Study the various analysis techniques.
4. Design and develop a computing model to predict the performance of experimental system.
5. Develop the following research proposal

   A. Individual B. Institutional

504305	Signal Processing for Wireless Communications	
ELECTIVE-I		
Teaching Scheme: **Lectures 4Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Spectrum Estimation And Modelling

Definition, Problem of PSE, Non parametric and parametric spectral estimation, least mean square estimation.

Adaptive Filters

Introduction to steepest descent adaptive filters, LMS algorithm, application to noise cancellation, RLS algorithm.

Module II

Basics of Signal Detection Theory

Definition of detection and estimation, review of deterministic and random signal concepts, Transformation of random variables using Gaussian density, Rayleigh density, Cauchy density, Uniform density, Chi squared density, Hypothesis testing, Bayes detection, Max detection, ML detection, Neyman Pearson criterion, Multiple hypothesis testing, composite hypothesis testing, Receiver operating characteristic and performance, Bayes estimation, Max estimation and ML estimation. Radar target detection and parameter estimation, dynamic target tracking.

Module III

Detection of Signals in White Gaussian Noise

Sign detector and its performance analysis, binary detection problem, matched filters, M-ary communication system, detection of signals with random parameters.

Module IV

Detection of Signals in Coloured Gaussian Noise

Derivation of correlation structure using an arbitrary orthonormal set, detection of known signals in coloured Gaussian noise, discrete time detection known signals embedded in coloured Gaussian noise.

References:

1. Introduction to statistical signal processing with application by M.D.Srinath, P.K.Rajasekaran and R.Vishwanathan, Pearson edition
2. Detection theory applications and digital signal processing by Ralph D Hippensteil, CRC press
3. Digital Signal Processing: Principles, Algorithms, And Applications, by John G. Proakis. Publisher, Pearson Education
4. Digital signal processing a practical approach by E Ifeachor and W.Jervis ,Prentice Hall

Signal Processing for Wireless Communications

Laboratory Assignments/Experiments:

1. Implement of Huffman coding and arithmetic coding.
2. Implement different probability distribution models.
3. Implement adaptive filters for noise cancellation application.
4. Implement different spectral estimation algorithm with applications.
5. Implement various speech codec's.

Implement image compression using wavelet transform.

504305	Communication Network	
ELECTIVE-I		
Teaching Scheme: **Lectures 4Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Types of networks :N/W components, N/W functions, Different networks.

Network design issues: Justifying network, scope, manageability, Architectures, Switching mode, Node placement sizing, link topology and sizing, Routing.

Data in support of Network design and Network design tools.

Module II

Analysis of loss and delay: Probability Distributions, M/M/1 queue & Other Queuing system.

System with loss. Erlang function, Poisson's function.

OSI model, Layers in OSI model, TCP / IP protocol suite, Protocols: Ping, FTP, telnet, http (www), SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, NFS, RPC, ICMP, IGMP, ARP, RARP,DHCP etc.TCP header, UDP header, IP header. Real time interactive Audio/Video protocol

Module III

Data link control: Framing, Flow control, Noiseless channel, Noisy channel, HDLC, PPP.

Multiple Access: Random Access, Controlled Access, Channelization.

Wired LANs: IEEE standards, Standard Ethernet, Changes in the Standards, Fast and Gigabit Ethernet,

Module IV

Wireless LANS: IEEE 802.11, Bluetooth.

Connecting LANS: Connecting devices, Backbone networks, Virtual LANS.

Virtual circuit networks: Architecture and Layers of Frame Relay and ATM.Security services in multimedia networking.

References:

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill.
2. Andrew S. Tannenbaum, "Computer Networks", Pearson Education
3. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, International Editions.
4. William Stallings "Cryptography and Network Security"
5. Stevens, TCP/IP illustrated Volume I and II

Communication Network

Laboratory Assignments/Experiments:

1. Study wire shark Network Protocol Analyzer Tool.
2. Study of Network Monitoring Tool.
3. Study and Implement Wireless Network Systems.
4. Study and Implement Socket Programming.

504305	Fiber Optic Communication	
ELECTIVE-I		
Teaching Scheme: **Lectures 4Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Overview of Optical Fiber Systems:

Block Diagram, Structures, Types, Mode Theory for Circular Waveguides, Modes, Waveguide Equations for SM and MM fibers, Fiber Optic Cables, Attenuation, Signal Distortion in Optical Waveguides, Mode Coupling, Optical Sources, Photo detectors, transmitter and receivers.

WDM Concepts and Components:

Operational Principles of WDM, Passive Components: 2 X 2 Fiber Coupler, Scattering Matrix Representation, 2 X 2 Waveguide Coupler, Star Couplers, Mach-Zehnder Interferometer Multiplexers, Fiber Grating Filters, Phased-Array-Based WDM Devices, Tunable Sources, Tunable Filters, System Considerations, Tunable Filter Types.

Module II

Optical Amplifiers:

Basic Applications and Types of Optical Amplifiers, Amplifier Types, Semiconductor Optical Amplifiers, External Pumping, Amplifier Gain, Erbium-Doped Fiber Amplifiers, Amplification Mechanism, EDFA Architecture, EDFA Power-Conversion Efficiency and Gain, Amplifier Noise, System Applications, Power Amplifiers, In-Line Amplifiers, Preamplifiers, Multichannel Operation, In-Line Amplifier Gain Control, Wavelength Converters, Optical Gating Wavelength Converters, Wave-Mixing Wavelength Converters.

Module III

SONET/SDH:

Introduction, Optical Components, SONET/SDH Networks, SONET/SDH Frames, Virtual Tributaries, STS-N/STM-N Frames, Synchronization and Timing, Maintenance, IP over SONET**.**

Module IV

Issues in WDM Optical Networks: Optical Network Architectures, Issues in Wavelength Routed Networks, Routing and Wavelength Assignment, Wavelength-Convertible Networks, Multifiber Networks, Wavelength Rerouting, Virtual Topology Design, Virtual Topology Reconfiguration, Survivable Networks, Optical Multicast Routing, Network Control and Management, Transmission Impairment, Ring Networks and Traffic Grooming, Virtual Private Networks over WDM Optical Networks.

Introduction to Wavelength routing algorithms

References:

1. G. Keiser, Optical Fiber Communications. Boston: McGraw Hill, 2000.
2. C. Siva Ram Murthy and M. Guruswamy, WDM Optical Networks. New Delhi: Prentice Hall of

India, 2002.
3. S. Kartalopoulos, Understanding SONET/SDH and ATM (IEEE Press). New Delhi: Prentice Hall of India, 2001.
4. W. Goralski, Optical Networking and WDM. New Delhi: Tata McGraw Hill, 2001.
5. U. Black, Optical Networks. New Delhi: Pearson Education, 2002.
6. J. Senior, Optical Fiber Communications. New Delhi: Prentice Hall of India, 1992

Fiber Optic Communication

boratory Assignments/Experiments:

1. Study of characteristics of fiber optic LED's, detectors, optical fiber
2. Study of losses in optical fiber
    a. Propagation, bending, connector losses,
    b. Effect of misalignment
3. Study of modulation and demodulation
4. Virtual prototype of optical communication system using simulation software
5. Analyze key characteristics of multimode optical communication systems such as Transverse mode profile, effective modal bandwidth, signal spectra, eye diagram etc using simulation software

504305	Mathematics for Microwave Engineering	
ELECTIVE-I		
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Multiple Integrals

Double integrals, triple integrals, application of multiple integrals, change of variables in multiple integrals.

Vector Calculus

Differentiation and integration of vectors, space curves, scalar and vector fields, vector operators: Gradient, divergence, curl, vector operator formulae, Cylindrical and spherical polar coordinates, general curvilinear coordinates.

Module II

Line, Surface and Volume Integrals

Line Integrals, connectivity of regions Green's theorem in a plane, Surface integrals, volume integrals, integral forms, Divergence theorem and related theorems, Stokes' theorem and related theorems.

Module III

Partial Differential Equations: General and Particular Solutions

Important partial differential equations, general form of solution, general and particular solutions, the wave equation, uniqueness of solution.

Module IV

Partial Differential Equations: Separation Of Variables and Other Methods

Separation of variables: the general method, Superposition of separated solutions, Separation of variables in polar coordinates, Integral transform methods, Inhomogeneous problems – Green's functions.

References:

1. K.F.Riley, M.P.Hobson, S.J.Bence, "Mathematical Methods for Physics and Engineering" 3rd edition, Cambridge University Press, 2006
2. I. S. Sokolnikiff, "Mathematical Methods of Physics and Engineering", McGraw Hill

.

Mathematics for Microwave Engineering
Laboratory Assignments/Experiments: 1. Application of Multiple Integrals. 2. Application of Green's Theorem for Antenna Analysis. 3. Solution of Wave Equation in Cartesian, Cylindrical, and Spherical Coordinate System. 4. Application of integral equations to the solution of Electromagnetic Problem.

504305	***LATEX**	
ELECTIVE-I		
Teaching Scheme: **Theory 1 Hrs/ Week**		**Examination Scheme:** **Credits :1**
LaTeX /Document Structure, Document classes, Packages, The document environment, Book structure.		
References:		
http://miktex.org/ http://www.winedt.com/		
*For each Subject under Elective I the student Shall study LATEX for 1 credit.		

504306	Lab Practice I	
Teaching Scheme: **Practical 4 Hrs/ Week**		**Examination Scheme:** **Term Work : 50 Marks** **Oral/ Presentation: 50 Marks** **Credits :4**
Lab Practice I: The laboratory work will be based on completion of minimum two assignments/experiments confined to the courses of the semester.		

SEMESTER-II

504308	RF and MMIC Technology	

Teaching Scheme: Lectures 4 Hrs/ Week		Examination Scheme: Theory : 50 Marks (In Semester) 50 Marks (End Semester) Credits : 4

Module I

MMIC Technology

Advantages, disadvantages, cost, performance, size and mass, reproducibility, reliability, applications, active device technology, design approach, multi-chip module technology.

Fabrication Technology

HEMT, HBT, BJT, FET, Resistors, capacitors, spiral inductors, via-holes and grounding, Microstrip couplers and splitters, Multi-layer techniques, thin film and multi-layer directional couplers and baluns.

Module II

Synthesis Techniques

Synthesis of linear and non linear MMIC, Matrix representation, network matrix decomposition, synthesis on n-port on the base of elementary two port, time domain method, method of harmonic balance, volterra series, describing function methods.

Module III

CAD Techniques

Integrated CAD design environment, CAD package feature, circuit simulation engine, commercial CAD packages like AWR microwave office, Cadence analog artist etc.

MMIC Design

Digital modulators, switches, phase shifters, multipliers and up-converters.

Module IV

MMIC Measurement

Device and circuit measurement techniques, measurement in M MIC media, MMIC test system, System applications of MMICs: Radio system, satellite communication, Broadcast system, Future trend in MMICs

References:

1. D.Robertson and S.Lucyszyn 'RFIc and MMIC design technology'
2. L.G.Maloratsky 'Passive RF and microwave integrated circuits'. Elsevier
3) Ivan Kneppo, Kluwer, "Microwave Integrated Circuits".

RF and MMIC Technology

Laboratory Assignments/Experiments:

1. To test and verify Microwave Integrated Circuits using Microstrip trainer kit and plot the results.
2. Using suitable software design, simulate and fabricate any one of the following mentioned MIC.
    a. Band pass filter (2.5 to 2.8 GHz)
    b. Band stop filter (2.5 to 2.8 GHz)
    c. Branch line coupler,
    d. Rat race hybrid coupler
3. Design an amplifier at 5GHz with S parameters as follows implement and simulate in suitable CEM software.
   $S_{11} = 0.73\angle 176^0, S_{21} = 3.32\angle 75^0$
   $S_{12} = 0.05\angle 34^0, S_{22} = 0.26\angle -107^0$
4. Check for amplifier stability and plot stability graph.(using suitable CEM software) Case Study of various numerical electromagnetic software's available.

504307	Computational Electromagnetics	
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Introduction to Computational Electromagnetics

Classification of Electromagnetic Problems, Classification of methods of analysis, mathematical frame work, Overview of Computational methods. Analytical methods and Orthogonal functions, Green's Function, Green function for two dimensions and for bounded regions.

Finite Difference Methods

Finite Difference Approximations , Treatment of Interface and Boundary Conditions, Finite Difference Analysis of Guiding Structures.

Module II

Finite Difference Time Domain Analysis

Pulse Propagation in a Transmission Line, FDTD Analysis in One-Dimension, Applications of One-Dimensional FDTD Analysis, FDTD Analysis in Two-Dimensions, FDTD Analysis in Three-Dimensions, Implementation of Boundary Conditions in FDTD, Advances in FDTD.

Module III

Variational Methods

Calculus of Variations, Stationary Functional and Euler Equations, The Ritz Variational Method, Applications of Ritz Approach, Construction of Functional from PDE, Method of Weighted Residuals

Module IV

Finite Element Methods

Basic Steps in finite element analysis, FEM analysis in one dimension, FEM analysis in two-dimension.

Method of Moments

Point Matching and Galerkin's Methods, Eigenvalue Analysis using MoM, Solution of Integral Equations using MoM , Fast Multipole Solution Methods for MoM , Comparison of FDM, FDTD, FEM and MoM, Hybrid Computational Methods

References:

1. Ramesh Garg, Analytical and Computational methods in Electromagnetics, Artech House, INC, 2008
2. Mathew N O Sadiku, Numerical Techniques in Electromagnetics with MATLAB, Third Edition, CRC Press, Taylor and Francis Group, 2009

Computational Electromagnetics

Laboratory Assignments/Experiments:

1. Write an assignment on classification, applications, merits and demerits of all the computational electromagnetic method.
2. Write survey paper on various commercial CEM software available.
3. Carry out the analysis of a given structure using FDTD.
4. Carry out the analysis of a given structure using MoM.
5. Carry out the analysis of a given structure using FEM.

504309	Wireless Communications System	

Teaching Scheme: Lectures 4 Hrs/ Week		Examination Scheme: Theory : 50 Marks (In Semester) 50 Marks (End Semester) Credits : 4

Module I

Overview of Wireless systems

Evolution of wireless communications systems from 1G to 4G, various wireless standards, tele-traffic engineering, Traffic measurement units, Traffic distribution, Grad e of service, Blocking probability, Erlang Distribution, Poisson's model, queuing theory.

Cellular Communications

Cell concept, Hexagonal geometry, co-channel interference ratio and its reduction, cell splitting, adjacent channel interference, multiple access techniques, spectral efficiency, hand off mechanisms.

Module II

Propagation Characteristics of Mobile Channel

Free-space attenuation, Attenuation over reflecting surface ,Effect of earth's curvature, Radio wave propagation, Characteristics of wireless channel, Multipath delay spread, Coherence bandwidth, and coherence time, Signal fading statistics, Level crossing rate and average fade duration, Propagation path-loss models, Indoor loss models, Fade margin, Link margin.

Module III

The GSM System and General Packet Radio Service (GPRS)

GSM features, System architecture, logical channels, GSM frame and Slot structures, Data services in GSM.

CDMA Technology

Direct Spread CDMA principles, Capacity of CDMA, Transmitter and Receivers, System features, system architecture, spectrum allocation.

Module IV

Universal Mobile Telecommunications System (UMTS)

System features, Wireless network architecture, Physical layer, MAC layer protocol, Radio Link control protocol, PDCP, BMC protocol, Radio resource control protocol, Beyond 3G.

References:

1. M.R Karim, Mohsen Sarraf, W-CDMA and cdma2000 for 3G Mobile Networks, McGraw-Hill, 2002

2. Vijay K Garg, Wirless Communications and Networking, Morgan Kaufmann Publishers, Elsevier Inc.,2007
3. William C.Y.Lee, "Mobile Cellular Telecommunications, Second Edition, Tata McGraw-Hill Edition
4. T.S. Rappaport, "Wireless Communications Principles And Practice", Pearson Education
5. Vijay Garg and Joseph Wilkes, "Principles And Applications Of GSM", Pearson Education

Wireless Communications System

Laboratory Assignments/Experiments:

1. Simulate BPSK-DSSS model (on Simulink/MATLAB)
2. Simulate FHSS (on Simulink/MATLAB)
3. Simulate RAKE receiver model (on Simulink/MATLAB)
4. Simulate 4-, 16- & 64-QAM (on Simulink/MATLAB)
5. GMSK modulation technique for GSM (Hardware or Simulation)
6. Receiver using Viterbi algorithm for GSM
7. BER using Viterbi algorithm for GSM
8. Study of GSM and CDMA set up

504310	Microstrip Antennas	
ELECTIVE-II		
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Introduction to Microstrip Antennas

Characteristics of MSAs, Feeding techniques, Methods of analysis, Radiation fields, Surface Waves, Various Micro strip Configurations, Applications.

Module II

Analytical Models for MSAs

Transmission line models, cavity model, Generalized cavity model, Multiport Network model, Radiation fields, Aperture Admittance, Mutual Admittance, Model for coaxial probe in MSA, comparison of Analytical Models, Full wave analysis of Micro strip Antennas, Special domain Full wave analysis, Mixed potential Integral Equation Analysis, FDTD analysis.

Module III

Rectangular Micro strip Antennas

Models for Rectangular MSA, Design considerations for rectangular MSA, Tolerance Analysis, Mechanical tuning, Quarter wave Rectangular patch antennas,

Circular MSAs

Analysis, design considerations, comparison of Circular MSAs with Rectangular MSAs.

Module IV

Fractal Antennas

Introduction to Fractal antennas, different types of fractal geometries, applications

Reconfigurable Antennas

Introduction to Reconfigurable antennas, Various types reconfigurable antennas: frequency, pattern, and polarization reconfigurable antennas, methods for achieving various reconfigurability, Various switching elements: PIN diode, MEMS, mechanical relays.

References:

1. Ramesh Garg, Prakash Bhartia, Inder Bahl, Apisak Ittipiboon, Micro strip Antenna Design Handbook, Artech House, 2001
2. Girish Kumar, K.P. Ray, Broadband Microstrip Antennas, Artech House, Inc, 2003

3. John Gianvittorio, Fractal Antenna Design, Characterization, and Applications, University of California, Los Angeles, 2000
4. Jennifer T Bernhard, Reconfigurable Antennas, Morgan & Clayopol Publishers, 2007

Microstrip Antennas

Laboratory Assignments/Experiments:(at least two experiments from the list to be executed)

1. Design, simulate, fabricate and test the rectangular microstrip.
2. Design, simulate, fabricate and test the circular microstrip.
3. Design, simulate, fabricate and test the array of rectangular microstrip.
4. Simulate, fabricate and test the fractal antenna.
   Simulate, fabricate and test the reconfigurable.

504310	Smart Antennas	
ELECTIVE-II		
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Introduction to Smart Antennas

Spatial Processing for Wireless Systems, Key Benefits of Smart Antenna Technology, Introduction to Smart Antenna Technology, the Vector Channel Impulse Response and the, Spatial Signature, Spatial Processing Receivers , Fixed Beam forming Networks , Switched Beam Systems.

Module II

Adaptive Antenna Systems

Adaptive Antenna System, Adaptive Beam forming, Wideband Smart Antennas Spatial Diversity, Diversity Combining, and Sectoring, Digital Radio Receiver Techniques and Software Radios for Smart Antennas, Transmission Beam forming.

Smart Antennas Techniques for CDMA

Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial Processors and the Spatial, Processing Rake Receiver , Multi-User Spatial Processing , Dynamic Re-sectoring Using Smart Antennas , Downlink Beam forming for CDMA.

Module II

CDMA System Range and Capacity Improvement Using Spatial Filtering

Range Extension In CDMA, Single Cell Systems with Spatial Filtering at the Base Station Reverse Channel Performance of Multi-cell Systems with Spatial Filtering at the Base Station Reverse Channel Spatial Filtering at the WLL Subscriber Unit, Range and Capacity Analysis Using Smart Antennas - A Vector-Based Approach.

Module IV

Optimal Spatial Filtering and Adaptive Algorithms

Impact of Multipath on Optimal Spatial Filtering , Performance of Underloaded and Overloaded Adaptive Arrays , Adaptive Algorithms , Adaptive Algorithms for CDMA, Multitarget Decision-Directed Algorithm (MT-DD), Least Squares De-spread Re-spread Multitarget Array (LS-DRMTA) , Least Squares De-spread Re-spread Multitarget Constant Modulus Algorithm.

Module IV

Assignment: MATLAB simulation of smart antenna system and various algorithms.

References:

1. T.S. Rappaport and J.C. Liberti, Smart Antennas for Wireless Communications, Prentice Hall, NJ: Prentice Hall,1999
2. T.S. Rappaport, Smart Antennas: Adaptive Arrays, Algorithms, & Wireless Position Location, New York: Prentice-Hall,1998
3. R.T. Compton Jr., Adaptive Arrays – Concepts and Performance, Englewood, NJ: Prentice Hall, 1998

Smart Antennas

Laboratory Assignments/Experiments:

1. Simulate the adaptive array and plot its radiation pattern in MATLAB with MMSE approach.
2. Simulate the adaptive array and plot its radiation pattern in MATLAB with Applebaum approach.
3. Simulate switched beam antenna array using Butler matrix on suitable Computational electromagnetic software, fabricate and test.
   Implement the smart antenna system with various algorithms.

504310	Cognitive Radio	
ELECTIVE-II		
Teaching Scheme: **Lectures 4 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Software Defined Radio

Software Defined Radio Architecture , Digital Signal Processor and SDR Baseband Architecture Reconfigurable Wireless Communication Systems , Unified Communication Algorithm , Reconfigurable OFDM Implementation , Reconfigurable OFDM and CDMA , Digital Radio Processing , Conventional RF , Digital Radio Processing (DRP) Based System Architecture

Cognitive Radio Communications

Cognitive Radios and Dynamic Spectrum Access , the Capability of Cognitive Radios , Spectrum Sharing Models of DSA, Opportunistic Spectrum Access: Basic Components , Networking the Cognitive Radios, Analytical Approach and Algorithms for Dynamic Spectrum Access , Dynamic Spectrum Access in Open Spectrum , Opportunistic Spectrum Access , Opportunistic Power Control, Fundamental Limits of Cognitive Radios

Module II

Cognitive Radio Networks

Network Coding for Cognitive Radio Relay Networks , System Model , Network Capacity Analysis on Fundamental CRRN Topologies , Link Allocation , Numerical Results , Cognitive Radio Networks Architecture, Network Architecture , IP Mobility Management in CRN , Terminal Architecture of CRN , Cognitive Radio Device Architecture , Re-configurable MAC , Radio Access Network Selection , QoS Provisional Diversity Radio Access Networks , Cooperative/Collaborative Diversity and Efficient Protocols , Statistical QoS Guarantees over Wireless Asymmetry, Collaborative Relay Networks , Scaling Laws of Ad-hoc and Cognitive Radio Networks , Network and Channel Models , Ad-hoc Networks , Cognitive Radio Networks .

Module III

Spectrum Sensing

Spectrum Sensing to Detect Specific Primary System , Conventional Spectrum Sensing , Power Control , Power-Scaling Power Control , Cooperative Spectrum Sensing , Spectrum Sensing for Cognitive OFDMA Systems , Cognitive Cycle , Discrimination of States of the Primary System , Spectrum Sensing Procedure , Spectrum Sensing for Cognitive Multi-Radio Networks, Multiple System Sensing , Radio Resource Sensing .

Module IV

Medium Access Control

MAC for Cognitive Radios , Multichannel MAC , General Description of Multichannel MAC , Multichannel MAC: Collision Avoidance/Resolution, Multichannel MAC: Access Negotiation , Slotted-ALOHA with Rate-Distance Adaptability, System Model , CSMA with AMC , Carrier Sense Multiple Access with Spatial-Reuse, Transmissions , Analysis of CSMA-ST , A Cross-Layer Power-Rate Control Scheme.

References:

1. Kwang-Cheng Chen and Ramjee Prasad *Cognitive Radio Networks* , John Wiley & Sons Ltd.,2009
2. Hüseyin Arslan , Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems Published by Springer 2007

Cognitive Radio

Laboratory Assignments/Experiments:

1. To study and simulate OFDM Transmitter and Receiver using Matlab/ Simulink.
2. To simulate spectrum sensing using matched filter detection using Matlab.
3. To simulate spectrum sensing using energy detection using Matlab.
4. To Implement cognitive radio using test beds Like USRP.

   To simulate cognitive radio environment using Matlab OR Suitable Network Simulators.

504310	Wave Propagation and Models	
ELECTIVE- II		
Teaching Scheme: **Lectures 4Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 4**

Module I

Introduction to Propagation of Radio Waves and Earth's Atmosphere

Propagation mechanisms, propagation environment, antennas, selectivity, propagation modelling. Earth's Atmosphere: Structure, Atmospheric Composition, Atmospheric parameters, weather phenomena.

Electromagnetic Waves and Propagation Characteristics

Basic properties of Electromagnetic waves, propagation mechanisms, main physical phenomena and frequency dependence.

Module II

Ionosphere and Terrestrial Fixed Links

Ionospheric refraction, trajectory calculation, Ionospheric forecasts, Radio electric parameters of the atmosphere, refraction, modelling of Cumulative Distributions of the refractivity gradient, main propagation mechanisms, propagation modelling.

Satellite Links

Free Space Attenuation, Phenomena associated to the Refractive Indexes, Attenuation by atmospheric gases, Hydrometeor attenuation, depolarization attenuation, building penetration loss, attenuation due to the local environment.

Module III

Propagation for Modern Wireless Systems

Propagation in the presence of buildings on flat terrain, modelling propagation over rows of low buildings, approaches to computing the reduction of the rooftop fields, plane wave incidence for macro cell predictions, shadow fading and effects of terrain and trees, shadow fading statistics, modelling of terrain effects, modelling effects of trees.

Module IV

Mobile Radio Links

Types of models, uses of models, macro cell models, small cell models, micro cell models, indoor propagation models, Broadband models.

Assignment: Literature survey of latest trends and seminar presentation.

References:

1. Herve Sizun, Radio Wave Propagation for Telecommunication Applications, Springer Berlin Heidelberg New York, 2005
2. Henry L Bertoni, Radio Propagation for Modern Wireless System Design, Pearson Education, Inc, 2009
3. Les Barclay, Propagation of Radio Waves, 2nd Edition, IET, 2003
4. Curt A Levis, Joel T Johson and etal, Radio Wave Propagation: Physics and Applications, John Wiley & sons, Inc, 2010

Wave Propagation and Models

Laboratory Assignments/Experiments:

1. Determine the free space loss and the power received using MATLAB.
2. Determine the median path loss for Okumura model for outdoor propagation.
3. Determine the median path loss for Hata model for outdoor propagation.
4. Study of 'Radio Refractive Index (its formula and refractivity)'
5. Study of EM wave propagation and scattering in rain and other hydrometeors (Model if possible)
6. Modelling for estimation of fast fading distribution function.

   Radio wave propagation modelling.

504310	*Software Tools	
ELECTIVE-II		
Teaching Scheme: **Theory 1 Hrs/ Week**		**Examination Scheme:** **Credits :1**
Introduction to software tools such as Octave, MATLAB, LAB VIEW, RTLinux, VxWorks, µCOS-II, Tiny OS, ANDROID, Xilinx, Microwind, Tanner, TCAD Tools, NS-II, NS-III, OMNET++, OPNET, AWR Microwave office, CAD Feko, IE-3D.		
*For each Subject under Elective II the student Shall study open source/evaluation versions of at least two software tools mentioned above and should present term paper.		

504311	Lab Practice II	
Teaching Scheme: **Practical 4 Hrs/ Week**		**Examination Scheme:** **Term Work : 50 Marks** **Oral/ Presentation: 50 Marks** **Credits : 4**
Lab Practice II: The laboratory work will be based on completion of minimum two assignments/experiments from each course of the semester.		

SEMESTER III

604301	EMI and EMC Techniques	

Teaching Scheme: Practical 4 Hrs/ Week		Examination Scheme: Theory : 50 Marks (In Semester) 50 Marks (End Semester) Credits : 4

Module I

Sources and effects of EMI

Intersystem and intra system: EMI predictions and modelling; Cross talk: cable wiring and coupling: shielding and shielding materials. Grounding and bounding

Module II

Transmitter and Receiver Models for EMI Predictions

Types of emissions: Amplitude culling Frequency culling. Detail prediction and Performance prediction of various emissions. Receiver EMI functions. Receiver models for amplitude culling, frequency culling, Detail predictions and performance prediction

Antenna and Propagation Models for EMI Prediction

Antenna EMI prediction considerations, Antenna models for amplitude culling, frequency culling and detail prediction. Propagation considerations, Propagation models for amplitude culling, Propagation models and detail prediction

Module III

EMI measurements

Open area test site measurements. Measurement precautions: Radiated and Conducted interference measurements; control requirements and test methods.

Module IV

Grounding, Shielding, and Bonding

Shielding and shielding materials, Grounding and bonding techniques.

EMI Filters and Standards

EMI filters characteristics of LPF, HPF, BPF and BEF, EMI standards-Military and industrial standards. FCC regulations.

References:

1. Prasad Kodali V., Engineering Electromagnetic Compatibility, IEEE press, 1996
2. David A Weston, Electromagnetic Compatibility: Principles and Applications, Marcel Decer, 2001
3. Kaiser BE., Principles of Electromagnetic Compatibility,3rd edition, Norwood MA: Artech House, 1987

EMI and EMC Techniques

Laboratory Assignments/Experiments:

1. Insertion loss
2. EMI filters (LPF, HPF, BPF)
    a. Common mode filter
    b. Differential Mode filter
3. Shielding Effect
4. Radiated emission

    Conducted emission

604302	Radar and Satellite Communication	
Teaching Scheme: Practical 4 Hrs/ Week		**Examination Scheme: Theory : 50 Marks (In Semester) 50 Marks (End Semester) Credits : 4**
Module I		
Fundamentals of Radar Radar equation and Radar Cross Section. Methods for RCS Estimation: GO, PO, GTD and PTD techniques. Ray tracing. RCS of simple and complex targets. Pulse radar, CW radar, blocks, design of blocks, Display methods and numerical based on this topic.		
Module II		
Fundamentals of surveillance Radar Radar design, PRF, unambiguous range and velocity, pulse length, sampling, clutters. Tracking and search radar, antenna beam shapes required, Radar guidance, frequency agility. **Tracking Radar and Pulse Radar** Real array Imaging radars. Synthetic array, Radars. Signal processing methods, Applications of radar in remote sensing, Geological survey, weather prediction		
Module III		
Introduction To Satellite Systems Orbital mechanism and launching of artificial satellite, types of satellite as per altitude, Kepler's law, equations, satellite orbit, look angle calculation, orbital perturbation. **Satellite Subsystems** AOCS, TTC & M, power requirement, satellite antenna. Satellite link design.		
Module IV		
Multiple Access Techniques Multiple access techniques FDMA, TDMA, SS-TDMA; Interference in FDMA systems. Power budget analysis, Applications and recent trends in satellite systems.		
References:		

1. S,Kingslay,S.Quegan , Understanding of Radar TMH 1993.
2. Radar Handbook, by Merrill Skolnik
3. Radar system principle by H.R.Raemer CRC press.
4. Satellite communication by T Pratt,C.Bostian and J.Allnutt.Wiley.
5. Satellite communication by D.Roddy Mcgrawhill.

Radar and Satellite Communication

Laboratory Assignments/Experiments:

1. Simulate satellite transponder.
2. Simulate low power satellite link using suitable software.
3. Simulate RADAR system using suitable software.
4. Calculate RCS of sphere, cone of a given object.

   Simulate different modulation schemes used in satellite system.

Elective-III

Select one subjects from Group-I, and one subject from Group-II from the following list as Elective-III.

Group		Subject	Credit
I	1	Value Education, Human Rights and Legislative Procedures	3
	2	Environmental Studies	3
	3	Energy Studies	3
	4	Disaster Management	3
	5	Knowledge Management	3
	6	Foreign Language	3
	7	Economics for Engineers	3
	8	Engineering Risk – Benefit Analysis	3
II	1	Technology Play	2
	2	Optimization Techniques	2
	3	Fuzzy Mathematics	2
	4	Design and Analysis of Algorithms	2
	5	CUDA	2

604103	Value Education, Human Rights and Legislative Procedures	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I

Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.

Module II

Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.

Module III

Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.

Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries

References:

1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001.
2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002.
3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002.
4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990.
5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Ox ford University Press, New Delhi, 2000.

604103	Environmental Studies	Group I

ELECTIVE- III

Teaching Scheme:		Examination Scheme:
Lectures 3 Hrs/ Week		**Theory:50 Marks (In Semester)** **50 Marks (End Semester)** **Credits 3**

Module I:

Introduction and Natural Resources: Multidisciplinary nature and public awareness, Renewable and nonrenewal resources and associated problems, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Conservation of natural resources and human role.
Ecosystems: Concept, Structure and function, Producers composers and decomposers, Energy flow, Ecological succession, Food chains webs and ecological pyramids, Characteristics structures and functions of ecosystems such as Forest, Grassland, Desert, Aquatic ecosystems.

Module II

Environmental Pollution- Definition, Causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, human role in prevention of pollution, Solid waste management, Disaster management, floods, earthquake, cyclone and landslides.

Module III:

Social issues and Environment- Unsustainable to sustainable development, Urban problems related to energy, Water conservation and watershed management, Resettlement and re-habitation, Ethics, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents, holocaust, Waste land reclamation, Consumerism and waste products, Environment protection act, Wildlife protection act, Forest conservation act, Environmental issues in legislation, population explosion and family welfare program, Environment and human health, HIV, Women and child welfare, Role of information technology in
environment and human health.

References:

1. Agarwal, K.C., Environmental Biology, Nidi Publication Ltd., Bikaner, 2001.
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmadabad, 2002.
3.Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi, 2003.
4.Cunningham, W.P., et al. , Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2003.

604103	Energy Studies	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I:

Energy Sources : Fossil fuels, Nuclear fuels, hydel, solar, wind and bio fuels in India, Energy conservation, Nuclear energy through fission and fusion processes.

Module II:

Energy Conservation: Energy conversion from source to utility, Solar, Nuclear, Geothermal, Tide and Wind Energies.

Global Energy Scenario: Role of energy in economic development and social transformation, Overall energy demand, availability and consumption, Depletion of energy resources and its impact on economy, Non proliferation of nuclear energy. International energy policies of G-8, G-20, OPEC and European union countries.

Module III:

Indian Energy Scenario- Commercial and noncommercial forms of energy, Utilization pattern in the past, present and also future prediction, Sector wise energy consumption.

Energy Policy: Energy policy issues at global level, national level and state level, Energy conservation act 2001, Electricity act 2003, Energy pricing and its impact on global variations

References:

1. Jose Goldenberg, Thomas Johanson, and Reddy, A.K.N., Energy for Sustainable World, WileyEastern ,2005.
2. Charles E. Brown, World Energy Resources, Springer Publication, New York, 2002.
3. Culp, A.W., Principles of Energy Conversion, McGraw Hill New York, 2004.
4. Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi, 2003.

604103	Disaster Management	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I

Introduction :Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation). Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility

Module II

Disaster Impacts :Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate-change and urban disasters.

Module III

Disaster Risk Reduction (DRR) : Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

References:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority).
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management ,APH Publishing Corporation.

604103	Knowledge Management	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I

Introduction: Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge; Learning organization: five components of learning organization, knowledge sources, and documentation. Essentials of Knowledge Management; knowledge creation process, knowledge management techniques, systems and tools.

Module II

Organizational knowledge management; architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization. Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies

Module III

Futuristic KM: Knowledge Engineering, Theory of Computation, Data Structure.

References:

1. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004.
2. Knowledge Management- Elias M. Awad Hasan M. Ghazri, Pearson Education
3. The KM Toolkit – Orchestrating IT, Strategy & Knowledge Platforms, Amrit Tiwana, Pearson, PHI, II Edn.
4. The Fifth Discipline Field Book – Strategies & Tools For Building A learning oganization PeterSenge et al. Nicholas Brealey 1994
5. Knowledge Management – Sudhir Warier, Vikas publications
6. Leading with Knowledge, Madanmohan Rao, Tata Mc-Graw Hill.

604103	Foreign Language	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**
Module I:		
Pronunciation guidelines; Single vowels, Accentuated vowels, Vowels and consonants combinations, Consonants; Numbers 1-10 Articles and Genders; Gender in French, Plural articles, Some usual expressions. Pronouns and Verbs; The verb groups, The pronouns, Present tense, Some color Adjectives and Plural ; Adjectives, Some adjectives, Our first sentences, More Numbers.		
Module II:		
Sentences Structures; Some Prepositions, Normal Sentences, Negative Sentences, Interrogative Sentences, Exercises The Family; Vocabulary ,Conversation, Notes on Pronunciation, Notes on Vocabulary, Grammar, Liaisons Guideline. D'où viens-tu (Where do you come from); Vocabulary, Conversation, Notes on Vocabulary, Liaisons Guidelines . Comparer (Comparing); Vocabulary, Conversation, Notes on Vocabulary, Grammar Liaisons Guidelines, Ordinal Numbers		
Module III:		
Le temps (Time); Vocabulary, Grammar, Time on the clock Additional French Vocabulary; Vocabulary related to - The Family, Vocabulary related to - Where do you come from? French Expressions and Idioms; Day-to-day Life, At Work, The car, Sports, Specia Events Other French Flavours; Nos cousins d'Amérique - Québec et Accadie, Au pays de la bière et des frites, Mettez-vous à l'heure Suisse, Vé, peuchère, le français bien de chez nous		
Reference: http://www.jump-gate.com/languages/french/index.html		

604103	Engineering Economics	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I:

Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering, Technology and Economic Development. Production Possibility Curve, Nature of Economic Law, **Time Value of Money:** concepts and application. Capital budgeting; Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI (with the help of case studies)

Module II:

Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry. Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (Main features). Supply and law of supply, Role of demand and supply in price determination.

Module III:

Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks

Text Books:

1. Jain T.R., Economics for Engineers, VK Publication
2. Singh Seema, Economics for Engineers, IK International

Reference Books:

1. Chopra P. N., Principle of Economics, Kalyani Publishers
2. Dewett K. K., Modern economic theory, S. Chand
3. H. L. Ahuja., Modern economic theory, S. Chand
4. Dutt Rudar & Sundhram K. P. M., Indian Economy
5. Mishra S. K., Modern Micro Economics, Pragati Publications
6. Pandey I.M., Financial Management; Vikas Publishing House
7. Gupta Shashi K., Management Accounting, Kalyani Publication

604103	Engineering Risk – Benefit Analysis	Group I
ELECTIVE- III		
Teaching Scheme: **Lectures 3 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 3**

Module I :

Introduction- Knowledge and Ignorance, Information Uncertainty in Engineering Systems, Introduction and overview of class; definition of Engineering risk; overview of Engineering risk analysis. Risk Methods: Risk Terminology, Risk Assessment, Risk Management and Control, Risk Acceptance, Risk Communication, Identifying and structuring the Engineering risk problem; developing a deterministic or parametric model System Definition and Structure: System Definition Models, Hierarchical Definitions of Systems, and System Complexity.

Module 2:

Reliability Assessment: Analytical Reliability Assessment, Empirical Reliability Analysis Using Life Data, Reliability Analysis of Systems

Module 3:

Reliability and probabilistic risk assessment (RPRA), decision analysis (DA), and cost-benefit analysis (CBA). All of these pertain to decision making in the presence of significant uncertainty. In ERBA, the issues of interest are: The risks associated with large engineering projects such as nuclear power reactors, the International Space Station, and critical infrastructures; the development of new products; the design of processes and operations with environmental externalities; and infrastructure renewal projects

Books:

1. Risk Analysis in Engineering and Economics, B. M. Ayyub, Chapman-Hall/CRC Press, 2003.
2. Hoyland, Arnljot, and Rausand, Marvin. *System Reliability Theory*. Hoboken, NJ: Wiley-Interscience, 1994. ISBN: 9780471471332.
3. Clemen, Robert, " Making Hard Decisions: An Introduction to Decision Analysis (Business Statistics) " PHI publications

604103	Optimization Techniques	Group II
ELECTIVE- III		
Teaching Scheme: **Lectures 2 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 2**

Module I :

First and second order conditions for local interior optima (concavity and uniqueness), Sufficient conditions for unique global optima; Constrained optimization with Lagrange multipliers; Sufficient conditions for optima with equality and inequality constraints;

Module 2:

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning

Books:

1. Stephen Boyd and Lieven Vandenberghe, *Convex Optimization*, Cambridge University Press.
2. A. Ben-Tal, A. Nemirovski, *Lectures on Modern Convex Optimization: Analysis,Algorithms, and Engineering Applications*, SIAM.
3. D. P. Bertsekas, A. Nedic, A. E. Ozdaglar, *Convex Analysis and Optimization*,Athena Scientific.
4. D. P. Bertsekas, *Nonlinear Programming*, Athena Scientific.
5. Y. Nesterov, *Introductory Lectures on Convex Optimization: A Basic Course*, Springer.
6. J. Borwein and A. S. Lewis, *Convex Analysis and Nonlinear Optimization:Theory and Examples*, Springer**.**

604103	Fuzzy Mathematics	Group II
ELECTIVE- III		
Teaching Scheme: **Lectures 2 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 2**
Module I :		
Definition of a Fuzzy set; Elements of Fuzzy logic. Relations including, Operations, reflexivity, symmetry and transitivity; Pattern Classification based on fuzzy relations		
Module II:		
Fuzzy Models: Mamdani , Sugeno, Tsukamoto		
Books: 1. Neuro-Fuzzy and Soft Computing by S.R.Jung, Sun, Mizutani,		

604103	Design and Analysis of Algorithm	Group II
ELECTIVE- III		
Teaching Scheme: **Lectures 2 Hrs/ Week**		**Examination Scheme:** **Theory :** **50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 2**
Module I :		
Introduction- Fundamental characteristics of an algorithm. Basic algorithm analysis –Asymptotic analysis of complexity bounds– best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms.		
Module II:		
Properties of big-Oh notation – Recurrence equations – Solving recurrence equations – Analysis of linear search. Divide and Conquer: General Method – Binary Search – Finding Maximum and Minimum – Merge Sort – Greedy Algorithms: General Method – Container Loading – Knapsack		
Books: Algorithm Design – Jon Kleinberg and Eva Tardos Introduction to Algorithms – T.H. Corman et. Al		

604103	CUDA	Group II
ELECTIVE- III		
Teaching Scheme: **Lectures 2 Hrs/ Week**		**Examination Scheme:** **Theory : 50 Marks (In Semester)** **50 Marks (End Semester)** **Credits : 2**

Module I :

History of GPUs leading to their use and design for HPC- The Age of Parallel Processing, The Rise of GPU Computing ,CUDA, Applications of CUDA, Development Environment, Introduction to CUDA C, Kernel call, Passing Parameters, Querying Devices, Using Device Properties

Module II:

Parallel Programming in CUDA C - CUDA Parallel Programming, Splitting Parallel Blocks, Shared Memory and Synchronization, Constant Memory, Texture Memory, CUDA events, Measuring Performance with Events.

Books:

1. Programming Massively Parallel Processors: A Hands-on Approach –second edition by David B. Kirk, Wen-mei W. Hwu.
2. CUDA by Example - An Introduction to General-Purpose GPU Programming by Jason Sanders ,Edward Kandrot- Addison Wesley
3. GPU Computing Gems Emerald Edition -Applications of GPU Computing Series by Wen-mei, W. Hwu
4. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs by shane cook

604104	Seminar II	
Teaching Scheme: **Practical 4 Hrs/ Week**		**Examination Scheme:** **Term Work : 50 Marks** **Oral/ Presentation: 50 Marks** **Credits :4**
Seminar II: Shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/Institute.		

604105	Project Stage- I	
Teaching Scheme: **Practical 8 Hrs/ Week**		**Examination Scheme:** **Term Work : 50 Marks** **Oral/ Presentation: 50 Marks** **Credits :8**
Project Stage – I Project Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.		

SEMESTER-IV

604106	Seminar III	
Teaching Scheme: **Practical 5 Hrs/ Week**		**Examination Scheme:** **Term Work : 50 Marks** **Oral/ Presentation: 50 Marks** **Credits :5**
Seminar III: shall preferably an extension of **seminar II.** The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.		

604107	Project Stage- II	
Teaching Scheme: **Practical 20 Hrs/ Week**		**Examination Scheme:** **Term Work : 150 Marks** **Oral/ Presentation: 50 Marks** **Credits :20**
Project Stage – II In Project Stage – II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis & validation of results and conclusions. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.		