K.S.INSTITUTE OF TECHNOLOGY, BANGALORE

(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

ADVANCED MATHEMATICS

Course Title: Engineering Mathematics - III	**Course Code : 14ELD11**
Credits: 04	**L-T-P : 4-0-0**
Contact Hours/Week : 04	**Total Hours: 50**
Exam. Marks : 100	**IA Marks : 50**
Exam. Hours : 03	

Matrix Theory

QR EL Decomposition – Eigen values using shifted QR algorithm- Singular Value EL Decomposition - Pseudo inverse- Least square approximations

Calculus of Variations

Concept of Functionals- Euler's equation – functional dependent on first and higher order derivatives – Functionals on several dependent variables – Iso perimetric problems- Variational problems with moving boundaries

Transform Methods

Laplace transform methods for one dimensional wave equation – Displacements in a string – Longitudinal vibration of a elastic bar – Fourier transform methods for one dimensional heat conduction problems in infinite and semi infinite rod.

Elliptic Equation

Laplace equation – Properties of harmonic functions – Fourier transform methods for laplace equations. Solution for Poisson equation by Fourier transforms method

Linear and Non Linear Programming

Simplex Algorithm- Two Phase and Big M techniques – Duality theory- Dual Simplex method. Non Linear Programming –Constrained extremal problems- Lagranges multiplier method- Kuhn- Tucker conditions and solutions

Reference Books:

1. Richard Bronson, **"Schaum’s Outlines of Theory and Problems of Matrix Operations"**, McGraw-Hill, 1988.
2. Venkataraman M K, **"Higher Engineering Mathematics"**, National Pub. Co, 1992.
3. Elsgolts, L., **"Differential Equations and Calculus of Variations"**, Mir, 1977.
4. Sneddon,I.N., **"Elements of Partial differential equations"**, Dover Publications, 2006.
5. Sankara Rao, K., **"Introduction to partial differential equations"**, Prentice – Hall of India, 1995
6. Taha H A, **“Operations research - An introduction"**, McMilan Publishing co, 1982.

Antenna Theory and Design

Subject Code	: 14ECS12	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Antenna fundamental and definitions: Radiation mechanism - overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization.

Resonant Antennas: Wires and patches, Dipole antenna, Yagi-Uda antennas, Microstrip antenna.

Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.

Aperture antennas: Techniques for evaluating gain, Reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, FiECS representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.

Antenna Synthesis: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low sidelobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.

Method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.

Computational EM: FTTD methods, Geometrical optics, Wedge diffraction theory, Ray fixed coordinate system, Uniform theory of wedge diffraction, E--plane analysis of horn antennas. Cylindrical parabolic antennas, Radiation by a slot on a finite ground plane, Radiation by a monopole on a finite ground plane, Equivalent current concepts, Multiple diffraction formulation by a curved surfaces, Physical optics, Methods of stationary phase, physical theory of diffraction, Cylindrical parabolic reflector antennas.

Reference books:

1. C. A. Balanis, **"Antenna Theory Analysis and Design"**, John Wiley, 2nd edition, 1997.
2. J. D. Kraus, **"Antennas"**, McGraw Hill TMH, 3rd/4th edition.
3. Stutman and Thiele, **"Antenna theory and design"**, 2nd edition John Wiley and sons Inc.
4. Sachidnanda et al, **"Antennas and propagation"**, Pearson Education.

Probability and random Process

Subject Code	: 14ECS13	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction to probability theory: Experiments, Sample space, Events, Axioms, Assigning probabilities, Joint and conditional, Baye's theorem, Independence, Discrete random variables, Engineering example

Random variables, Distributions, Density functions: CDF, PDF, Gaussian random variable, Uniform, Exponential, Laplace, Gamma, Erlang, Chi-square, Rayleigh, Rician and Cauchy types of random variables.

Operation on a single random variable: Expected value, EV of random variables, EV of functions of random variables, Central moments, Conditional expected values.

Characteristics functions: Probability generating functions, Moment generating function, Engineering applications, Scalar quantization, Entropy and source coding.

Pairs of random variables: Joint PDF, Joint probability mass functions, Conditional distribution, Density and mass functions, EV involving pairs of random variables, Independent random variables, Complex random variables, Engineering application.

Multiple random variables: Joint and conditional PMF, CDF, PDF, EV involving multiple random variables, Gaussian random variable in multiple dimension, Engineering application, Linear prediction.

Random process: Definition and characterisation, Mathematical tools for studying random processes, Stationery and Ergodic random processes, Properties of ACF.

Example Processes: Markov processes, Gaussian processes, Poisson processes, Engineering application, Computer networks, Telephone networks.

Reference books:

1. S.L.Miller and D.C.Childers, **"Probability and random processes: application to signal processing and communication"**, Academic press/Elsevier 2004.

2. A.Papoullis and S.U.Pillai, **"Probability, random variables and stochastic processes”**, McGraw Hill 2002
3. Peyton Z. Peebles, **"Probability, Random variables and random signal principles"**, TMH, 4th edition, 2007.
4. H Stark and Woods, **"Probability, random processes and application"**, PHI, 2001.

Advanced Digital Communication

Subject Code	: 14ECS14	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Digital modulation techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature - modulation techniques, No-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit verses symbol error probabilities, Synchronization, Applications.

Coding techniques: Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and nonsystematic convolutional codes, Performance Bounds for Convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.

Communication through band limited linear filter channels: Optimum receiver for channel with ISI and AWGN, Linear equalization, Decision - feedback equalization, Reduced complexity ML detectors, Iterative equalization and decoding - Turbo equalization.

Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive equalization of Trellis - coded signals, Recursive least square algorithms for adaptive equalization, Self recovering (blind) equalization.

Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.

Digital communication through fading multipath channels: Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel, Coded wave forms for fading channels, Multiple antenna systems.

Reference books:

1. John G. Proakis, **"Digital Communication"**, McGraw Hill, 4th edition, 2001.

2. Bernard Sklar, **"Digital Communication - Fundamental and applications",** Pearson education (Asia), Pvt. Ltd., 2nd edition, 2001.

3. Simon Haykin, **"Digital communications",** John Wiley and Sons.

4. Andrew J. Viterbi, **"CDMA: Principles of spread spectrum communications",** Prentice Hall, USA, 1995.

Wireless and Mobile Networks

Subject Code	: 14ECS151	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Review of fundamentals of wireless communication and Networks: Wireless communication channel specifications, Wireless communication systems, Wireless networks, Switching technology, Communication problems, Wireless network issues and standards.

Wireless body area networks: Properties, Network architectures, Components, Technologies, Design issues, Protocols and applications.

Wireless personal area networks: Architectures, Components, Requirements, Technologies and protocols, Bluetooth and Zigbee.

Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications.

WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications, WWANs, cellular networks, Satellite Network, Applications.

Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.

Reference books

1. S. S. Manvi, and M. S. Kakkasageri, **"Wireless and Mobile network concepts and Protocols"**, Wiley, 1st edition, 2010.
2. P. Kaveh, Krishnamurthy, **"Principles of Wireless network: A unified approach",** PHI, 2006.
3. Iti Saha Mitra, **"Wireless communication and network: 3G and Beyond"**, McGraw Hill, 2009.
4. Ivan Stojmenovic, **"Handbook of Wireless networks and Mobile Computing"**, Wiley, 2009.
5. P. Nicopolitidis, M. S. Obaidat, et al, **"Wireless Networks"**, Wiley, 2009.
6. Yi-Bing Lin, Imrich Chlamtac, **"Wireless and Mobile Network Architectures"**, Wiley, 2009.
7. Mullet, **"Introduction to Wireless Telecommunication Systems and Networks"**, Cengage, 2009.

Automotive Electronics

Subject Code	: 14ELD152	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Automotive fundamentals overview - Four stroke cycle, Engine control, Ignition system, Spark plug, Spark pulse generation, Ignition timing, Drive train, Transmission, Brakes steering system, Battery, Starting system.

Air/Fuel system - Fuel handling, Air intake system, Air/Fuel management.

Sensors: Oxygen (O2/EGO) sensors, Throttle position sensor (TPS), Engine crankshaft angular position (CKP) sensor, Magnetic reluctance position sensor, Engine speed sensor, Ignition timing sensor, Hall effect position sensor, ShiECSed fiECS sensor, Optical crankshaft position sensor, Manifold absolute pressure (MAP) sensor - Strain gauge and capacitor capsule, Engine coolant temperature (ECT) sensor, Intake air temperature (IAT) sensor, Knock sensor, Airflow rate sensor, Throttle angle sensor.

Actuators: Fuel meeting actuator, Fuel injector, Ignition actuator.

Exhaust after treatment systems: Air, Catalytic converter, Exhaust gas recirculation (EGR), Evaporative emission systems.

Electronic engine control: Engine parameters, Variables, Engine performance terms, Electronic fuel control systems, Electronic ignition controls, Idle speed control, EGR control.

Communication: Serial data, Communication systems, Protection, Body and chassis electrical systems, Remote keyless entry, GPS.

Vehicle motion control: Cruise control, Chassis, Power brakes, Antilock brake systems, (ABS), Electronic steering control, Power steering, Traction control, Electronically controlled suspension.

Automotive instrumentation: sampling, Measurement and signal conversion of various parameters.

Integrated body: Climate control systems, Electronic HVAC systems, Safety systems - SIR, Interior safety, lighting, Entertainment systems.

Automotive diagnostics: Timing light, Engine analyser, On-board diagnostics, off-board diagnostics, Expert systems.

Future automotive electronic systems: Alternative fuel engines, Collision avoidance radar warning systems, Low tire pressure warning system, Radio navigation, Advance driver information system.

Reference books

1. William B. Ribbens, **"Understanding Automotive Electronics"**, SAMS/Elsevier publishing, 6th edition.
2. Robert Bosch Gmbh, **"Automotive Electrics, Automotive Electronics Systems And Components"**, John Wiley and sons Ltd., 5th edition, 2007.

Nanoelectronics

Subject Code	: 14ELD153	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction: Overview of nanoscience and engineering, Development milestones in microfabrications and electronic industry, Moore's Law and continued miniaturization, Classification of nanostructures, Electronics properties of atoms and solids: Isolated atom, bonding between atoms, Giant molecular solids, Free electron models, Energy bands, Crystalline solids, Periodicity of crystal lattices, Electronic conduction, Effects of nanometer length scale, Fabrication methods: Top-down processes, Bottom-up processes methods for templating the growth of the nanomaterials, Ordering nanosystem.

Characterization: Classification, Microscopic techniques, FiECS ion microscopy, Scanning probe techniques, Diffraction techniques: Bulk, Surface spectroscopy techniques: Photon, radio frequency, electron, surface analysis and depth profiling; Electron mass ion beam reflectometry, Techniques for property measurements: Mechanical , Electron, Magnetic, Thermal properties.

Inorganic Semiconductor nanostructures: Overview of semiconductor physics, quantum confinement in semiconductor, nanostructures: Quantum wells, Quantum wires, Quantum dots, Superlattices, Band offsets, Electronic density of states.

Fabrication techniques: Requirement of ideal semiconductors, Epitaxial growth of quantum wells, Lithography and etching, Cleaved edge overgrowth of vicinal substrates, strain induced dots and wires, Electrostatically induced dots and wires, quantum well width fluctuations, Thermally annealed quantum wells, Semiconductor nanocrystals, Colloidal quantum dots, Self assembly techniques.

Physical processes: Modulation doping, Quantum hall effect, Resonant tunnelling, Charging effects, Ballistic carrier transport, Interband absorption, Intraband absorption, Light emission processes, Phonon bottleneck, Quantum confined stark effect, Nonlinear effects, Coherence and dephasing, characterization of semiconductor nanostructures: Optical, Electrical and structural.

Methods of measuring properties - Structure: Atomic, Crystallography, Microscopy, Spectroscopy. Properties of nanoparticles: Metal nanoclusters, Semiconducting nanoparticles, Rare gas and molecular clusters, Methods of synthesis (RF, Chemical, Thermolysis, Pulse laser methods). Carbon nano structures and its applications (FiECS emission and shiECSing, Computers, Fuel cells, Sensors, Catalysis). Self assembling nanostructure molecular materials and devices: Building block, Principles of self assembly, Methods to prepare and pattern nanoparticles, Templated nanostructures, Liquid crystal mesophases. Nanomagnetic materials and devices: Magnetism, materials, Magneto resistance, Nanomagnetism in technology, Challenges facing into nanomagnetism.

Applications: Injection Lasers: Quantum cascade lasers, Single photon sources. Biological tagging, Optical memories, Coulomb blockade devices, Photonic structures, QWIP's, NEMS, and MEMS.

Reference books:

1. Ed Robrt Kelsall, Ian Hamley, and Mark Geoghegan, **"Nanoscale Science and Technology"**, John Wiley and Sons, 2007.
2. Charles P. Poole, Jr. Frank J. Owens, **"Introduction to Nanotechnology"** John Wiley, 2006, reprint-2011.
3. Ed William, A. Goddard III, Donald W. Brenner, Sergey Edward, Lyshevski, and Gerald J. Lafrate, **"Handbook of Nanoscience Engineering and Technology"**, CRC press, 2003.

CMOS VLSI Design

Subject Code	: 14ECS154	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

MOS transistor theory: NMOS/PMOS transistor, Threshold voltage equation, Body effect, MOS device design equation, Sub threshold region, Chanel length modulation, Mobility variations, tunnelling, Punch through, Hot electron effect MOS models, Small signal AC characteristic, CMOS inverters, An/Ap ratio, noise margin, Static load MOS inverters, Differential inverter, Transmission gate, Tristate inverter, BiCMOS inverter.

CMOS process Technology: Lambda based design rules, Scaling factor, Semiconductor technology overview, Basic CMOS technology, p-well/ n-well/ twin-well process. Current CMOS enhancement (oxide isolation, LDD, refractory gate, Multilayer interconnect), Circuit element, resistor, Capacitor, Interconnects, Sheet resistance and standard unit capacitance concept delay unit time, Inverter delays driving capacitive loads, Propagate delays, MOS mask layer, Stick diagram, design rules and layout, Symbolic diagrams, MOS feints, Scaling of MOS circuits..

Basic of Digital CMOS design: Combinational MOS logic circuits -Introduction, CMOS logic circuits with the a MOS load, CMOS logic circuits, Complex logic circuits, transmission gate, Sequential MOS logic circuits - Introduction, Behaviour of high stable elements, SR latch circuits, Clocked latch and flip-flop circuits, CMOS D-latch and triggered flip-flop, Dynamic logic circuits - Introduction, principles of pass transistor circuits, Voltage bootstrapping synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques.

CMOS analog design: Introduction, Single amplifier, Differential amplifier, Current mirrors, Bandgap references, Basis of cross operational amplifier.

Dynamic CMOS and clocking: Introduction, Advantages of CMOS over NMOS, CMOS/SOS technology, CMOS/bulk technology, Latchup in bulk CMOS, Static CMOS design, Domino CMOS structure and design, Charge sharing, Clocking - Clock generation, Clock distribution, Clocked storage elements.

Reference books:

1. Neil Weste and K. Eshraghian, **"Principles of CMOS VLSI design: A system perspective"**, Pearson education (Asia) Pvt. Ltd. 2nd edition, 2000.
2. Wayne Wolf, **"Modern VLSI design: System on Silicon",** Pearson education, 2nd edition.
3. Douglas A. Pucknell and Kamram Eshraghian, **"Basic VLSI design",** PHI, 3rd edition, (original edition - 1994).
4. Sung Mo Kang and Yosuf Lederabic Law, "**CMOS digital integrated circuits: Analysis and design"**, McGraw Hill, 3rd edition.

Simulation, Modelling, and Analysis

Subject Code	: 14ELD155	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Basic simulation modeling: Nature of simulation, System models, discrete event simulation, Single server simulation, Alternative approaches, Other types of simulation.

Building valid, credible and detailed simulation models: techniques for increasing model validity and credibility, comparing real world observations.

Selecting input probability distributions: Useful probability distributions, Assessing sample independence, Activity-I, II and III, Model of arrival process.

Random number generators: Linear congruential, Other kinds, Testing number generators, Random variate generation: Approaches, Continuous random variates, Discrete random variates, Correlated random variates.

Output data analysis: Statistical analysis for terminating simulation, Analysis for steady state parameters, Comparing alternative system configuration, Confidence interval, Variance reduction techniques, Arithmetic and control variates.

Reference books:

1. Averill Law, **"Simulation modeling and analysis"**, McGraw Hill 4th edition, 2007.
2. Jerry Banks, **"Discrete event system Simulation"**, Pearson, 2009.
3. Seila Ceric and Tadikamalla, **"Applied simulation modeling"**, Cengage, 2009.
4. George. S. Fishman, **"Discrete event simulation"**, Springer, 2001.
5. Frank L. Severance, **"System modeling and simulation"**, Wiley, 2009.

DEC Lab – 1

Subject Code	: 14ECS16	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Experiments can be done using Hardware tools such as Spectrum analyzers, Signal sources, Power Supplies, Oscilloscopes, High frequency signal sources, fiber kits, Measurement benches, DSP processor kit, FPGA kit, Logic analyzers, PC setups, etc. Software tools based experiments can be done using, FEKO simulator, NS2 simulator, MATLAB, etc.

1. Matlab/C implementation of to obtain the radiation pattern of an antenna.
2. Experimental study of radiation pattern of different antennas.
3. Significance of pocklington's integral equation.
4. Measurement techniques of radiation characteristics of an antenna.
5. Impedance measurements of Horn/Yagi/dipole/Parabolic antennas.
6. Analysis of E & H plane horns.
7. Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.
8. Determination of the modes transit time, electronic timing range and sensitivity of klystron source.
9. Antenna resonance and gain bandwidth measurements.
10. Study of digital modulation techniques using CD4051 IC
11. Build a hardware pseudo-random signal source and determine statistics of the generated signal source..
12. Conduct an experiment for Voice and data multiplexing using optical fiber.
13. Determination of VI characteristics of GUNN diode, and measurement of guide wave length, frequency, and VSWR.

14. Determination of coupling coefficient and insertion loss of directional couplers and Magic tree.
15. Determine the frequency response of BPSK, BFSK, and Binary ASK modulators using Spectrum analyzers.

Wireless Communication

Subject Code	: 14ECS21	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Wireless channel: Physical modeling for wireless channels, I/O model of wireless channels, time and frequency response, Statistical models

Point-to-Point Communication: Detection in Rayleigh fading channels, Time diversity, Antenna diversity, Frequency diversity, Impact of the channel uncertainty.

Diversity: Introduction Micro-diversity, Micro-diversity and Simulcast combination of signals, Error probability in fading channels with diversity reception, Transmit diversity.

Capacity of wireless channel: AWGN channel capacity, Resources of AWGN channel, Linear time invariant Gaussian channel, Capacity of fading channels.

MIMO Systems: Introduction, Space diversity and system based on space diversity, Smart antenna systems and MIMO, MIMO based system architecture; MIMO exploits multipath, Space time processing, Antenna considerations for MIMO. MIMO channel modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space time coding, advantages and applications of MIMO, MIMO application in 3G,

MIMO-1, Spatial multiplexing channel modeling: Multiplexing capability of MIMO channels, Physical modeling of MIMO channels. Modeling MIMO fading channels,

Multi antenna systems, Smart antennas, Multiple Input and Multiple Output systems.

Reference books:

1. David Tse, P. Vishwanath, **"Fundamentals of Wireless Communication",** Cambridge, 2006.

2. Ke-Lin Du, ad M.N.S. Swamy, **"Wireless communication systems-From RF subsystems to 4G enabling Technologies",** Cambridge, South Asian 2010 edition.

3. C. Y. William, Lee, **"Mobile communication engineering theory and applications",** TMH, 2008.

4. Upen Dalal, **"Wireless communication",** Oxford, 2009.

5. Mark Ciampa, Jorge Olenwa, **"Wireless communication",** Cengage, 2007.

RF and Microwave Circuit Design

Subject Code	: 14ECS22	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Wave propagation in network: Introduction, Reasons for using RF/Microwaves, Applications', RF waves, RF and Microwave circuit design, Introduction to components basics, Analysis of simple circuit phasor domain, RF impedance matching, Properties of waves, transmission media, Micro strip lines, High frequency parameters, Formulation of S-parameters, Properties, transmission matrix, Generalized S-parameters.

Passive circuit design: Introduction, Smith chart, Scales, Application of Smith chart, Design of matching networks, Definition of impedance matching, Matching using lumped and distributed elements.

Basic consideration in active networks and design of amplifiers, oscillators and detector: Stability consideration, gain consideration, Noise consideration. Linear and nonlinear design: Introduction, Types of amplifier, Design of different types of amplifiers, Multistage small signal amplifiers, Design of transistor oscillators, Detector losses, detector design.

Mixers Phase shifters and RF and Microwave IC design: Mixer types, Conversion loss for SSB mixers, One diode mixer, Phase shifters, Digital phase shifters, Semiconductor phase shifters, RF and microwave IC design, MICs, MIC materials, Types of MICs, Hybrid verses monolithic ICs, Chip materials.

Reference books:

1. Matthew M. Radmanesh, **"RF and Microwave Electronics Illustrated",** Pearson Education edition, 2004.
2. Reinhold Ludwig, and Pavel Bretchko,**"RF circuit design theory and applications",** Pearson Education edition, 2004.

Modern DSP

Subject Code	: 14ECS23	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction and Discrete Fourier transforms: Signals, Systems and processing, Classification of signals, The concept of frequency in continuous time and discrete time signals, Analog to digital and digital to analog conversion, Frequency-domain sampling. The discrete Fourier transform, Properties of the DFT, Linear filtering methods based on the DFT.

Design of digital filters: General considerations, design of FIR filters, Design of IIR filters from analog filters, Frequency transformations.

Multirate digital signal processing: Introduction, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank.

Adaptive filter: Applications of adaptive filters, Adaptive direct form FIR filters, The LMS algorithm, Adaptive direct form filters, RLS algorithm.

Reference books:

1. Proakis, and Manolakis, "Digital signal processing", 3rd edition, Prentice Hall, 1996.

2. Robert. O. Cristi, "Modern Digital signal processing", Cengage Publishers, India, 2003.

3. S. K. Mitra, "Digital signal processing: A computer based approach", 3rd edition, TMH, India, 2007.

3. E.C. Ifeachor, and B. W. Jarvis, "Digital signal processing: A Practitioner's approach", Second Edition, Pearson Education, India, 2002, Reprint.

Optical Communication and Networking

Subject Code	: 14ECS24	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction: Propagation of signals in optical fiber, Different losses, Nonlinear effects, Solutions, Optical sources, Detectors.

Optical components: Couplers, Isolators, Circulators, Multiplexers, Filters, Gratings, Interferometers, Amplifiers.

Modulation - Demodulation: Formats, Ideal receivers, Practical detection receivers, Optical preamplifiers, Noise considerations, Bit error rates, Coherent detection.

Transmission system engineering: System model, Power penalty, Transmitter, Receiver, Different optical amplifiers, Dispersion.

Optical Networks: Client layers of optical layer, SONET/SDH, Multiplexing, layers, Frame structure, ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, ESCON, HIPPL.

WDM network elements: Optical line terminal, Optical line amplifiers, Optical cross connectors, WDM network design, Cost trade offs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion, Statistical dimensioning model.

Control and management: Network management functions, management framework, Information model, management protocols, Layers within optical layer performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management.

Reference books:

1. John M. Senior, **"Optical fiber communication",** Pearson edition, 2000.
2. Rajiv Ramswami and K. N. Sivarajan, **"Optical Networks",** Morgon Kauffman Publishers, 2000.
3. Gerd Kaiser, **"Optical fiber Communication Systems",** John Wiley, New York, 1997.
4. P. E. Green, **"Optical Networks",** Prentice Hall, 1994.

Broadband Wireless Networks

Subject Code	: 14ECS251	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

WiMAX Genesis and framework: 802.16 standard, WiMAX forum, Other 802.16 standards, Protocol layer topologies - Layers of WiMAX, CS, MAC CPS, Security layer, Phy layer, Reference model, topology.

Frequency utilization and system profiles: Cellular concept, Licensed and unlicensed frequencies, Fixed WiMAX system profiles, Mobile WiMAX profiles.

WiMAX physical layer: OFDM transmission, SOFDMA, subcarrier permutation, 802.16 transmission chains, Channel coding, Turbo coding, Burst profile.

WiMAX MAC and QoS: CS layer, MAC function and frames, Multiple access and burst profile, Uplink bandwidth allocation and request mechanisms, Network entry and QoS management.

Radio engineering considerations: Radio resource management, Advance antenna technology in WiMAX, MBS. WiMAX architecture, Mobility handover and power save modes, Security.

Reference books:

1. Loutfi Nuyami, **"WiMAX - Technology for broadband access"**, John Wiley, 2007.

2. Yan Zhang, Hsia-Hwa Chen, **"Mobile WiMAX"**, Aurobech Publications, 2008.

ASIC Design

Subject Code	: 14ECS252	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction: Full custom with ASICs, Semicustom ASICs, Standard cell based ASIC, Gate array based ASIC, Channelled gate array, Channel less gate array, structured gate array, Programmable logic device, FPGA design flow, ASIC cell libraries.

Data logic cells: Datapath elements: Adders, Multipliers, Arithmetic operator, I/O cell, Cell compilers.

ASIC Library design: Logical effort: Practicing delay, Logical area and logical efficiency, Logical paths, Multi stage cells, optimum delay, Optimum number of stages, Library cell design.

Low-level design entry: Schematic entry: Hierarchical design, The cell library, Names, Schematic, Icons and symbols, Nets, Schematic entry for ASICs, Connections, Vectored instances and buses, Edit in place attributes, Netlist, Screener, back annotation.

Programmable ASIC: Programmable ASIC logic cell, ASIC I/O cell.

A brief introduction to low level design Language: An Introduction to EDIF, PLA tools, An introduction to CFI designs representation, Half gate ASIC, Introduction to synthesis and simulation.

ASIC construction, floor planning and placement and routing: Physical design, CAD tools, System partitioning, Estimating ASIC size, Partitioning methods, Floor planning tools, I/O and power planning, Clocking planning, Placement algorithms, Iterative placement improvement, Ti driven placement methods, Physical design flow global routing, Logical routing, Detailed routing, Special routing, Circuit extraction and DRC.

Reference books:

1. M. J. S. Smith, "Application Specific Integrated Circuits", Pearson education, 200.

2. Jose E. France, Yannis Tsividis, "Design of Analog Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

3. Malcolm R. Haskard, and Lan. C. May, "Analog VLSI design - NMOS and CMOS", Prentice Hall, 1998.

4. Mohammad Ismail and Terri Fiez, "Analog VLSI signal and Information Processing", McGraw Hill, 1994.

Advanced Embedded System

Subject Code	: 14ECS253	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Typical embedded system: Core of the embedded system, Memory, Sensors and Actuators, Commutation interface, Embedded firmware, Other system components.

Characteristics and quality attribution of Embedded Systems.

Hardware software co-design and program modelling: Fundamental issues in hardware software co-design, Computational models in embedded design, Introduction to Unified modelling language, Hardware software trade-off.

Embedded firmware design and development: Embedded firmware design approaches, Embedded firmware development language.

Real time operating system (RTOS) based embedded system design: Operating system basics, Types of OS, Tasks, Process and threads, Multiprocessing and multitasking, Task scheduling, Threads, Processing and scheduling: Putting them altogether, Task communication, task synchronization, Device drivers, How to choose an RTOS.

The embedded system development environment: The Integrated development environment (IDE), Types of files generated on cross compilation, Disassembler/Decompilers, Emulators and debugging, Target hardware debugging, Boundary scan.

Trends in the embedded industry: Processor trends in embedded system, Embedded OS trends, development language trends, Open standards, Frameworks and alliances, Bottlenecks.

Reference books:

1. K. V. Shibu, **"Introduction to embedded systems",** TMH education Pvt. Ltd. 2009.
2. James K. Peckol, **"Embedded systems- A contemporary design tool",** John Wiley, 2008.

Multimedia communication

Subject Code	: 14ECS254	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Multimedia Communications: multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS. (Ref.1 Chap. 1)

Information Representation: text, images, audio and video, Text and image compression, compression principles, text compression, image compression. Audio and video compression, audio compression, video compression, video compression principles, video compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video.(Ref 1 Chap 3 &4)

Detailed Study of MPEG 4: coding of audiovisual objects, MPEG 4 systems, MPEG 4 audio and video, profiles and levels. MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework, Significant features of JPEG 2000, MPEG 4 transport across the Internet. (Ref2. Chap.5)

Synchronization: Notion of synchronization, presentation requirements, reference model for synchronization, Synchronization specification.

Multimedia operating systems, Resource management, process management techniques. (Ref. 3. Cahp 9 & 11)

Multimedia Communication Across Networks: Layered video coding, error resilient video coding techniques, multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, multimedia in mobile networks, multimedia in broadcast networks. (Ref.2 Chap. 6)

Assignments / Practicals can be given on writing the programs to encode and decode the various kinds of data by using the algorithms. Students can collect several papers from journals/conferences/Internet on a specific area of multimedia communications and write a review paper and make a presentation.

Reference Books:

1. Fred Halsall, “**Multimedia Communications**”, Pearson education, 2001
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “**Multimedia Communication Systems**”, Pearson education, 2004

3. Raif steinmetz, Klara Nahrstedt, “**Multimedia: Computing, Communications and Applications**”, Pearson education, 2002
4. John Billamil, Louis Molina, “**Multimedia : An Introduction**”, PHI, 2002

Spread Spectrum Communication

Subject Code	: 14ECS255	IA Marks	50
No. of Lecture Hours /week	: 04	Exam Hours	03
Total no. of Lecture Hours	: 50	Exam Marks	100

Review of digital communication concepts, direct sequence and frequency hop spread spectrum systems.

Hybrid direct sequence/frequency hop spread spectrum. Complex envelop representation of spread spectrum signals.

Sequence generator fundamentals, Maximum length sequences. Gold and Kasami codes, Nonlinear Code generators.

Spread spectrum communication system model, Performance of spread spectrum signals in jamming environments, Performance of spread spectrum communication systems with and without forward error correction.

Diversity reception in fading channels, Cellular radio concept, CDMA cellular systems. Examples of CDMA cellular systems. Multicarrier CDMA systems. CDMA standards

Reference Books:

1. R. L. Peterson, R. E. Zeimer and D. E. Borth, **"Introduction to Spread Spectrum Communications"**, Pearson, 1995.
2. J. D. Proakis and M. Salehi, **"Digital Communication"**, McGraw Hill, 2008
3. A. J. Viterbi, **"CDMA: Principles of Spread Spectrum Communications",** Addision Wesley, 1995.
4. S. Verdu, **"Multiuser Detection"**, Cambridge University Press, 1998

DEC Lab – 2

Subject Code	: 14ECS26	IA Marks	: 25
No. of Lecture Hours / Week	: 03	Exam. Hours	: 03
Total No. of Lecture Hours	: 42	Exam. Marks	: 50

List of laboratory Experiments - Modern digital signal processing using MATLAB

1. Question based on response of LTI systems to diffrent inputs. A LTI system is defined by the difference equation y[n]=x[n]+x[n+1]+x[n+2].

(a) determine the impulse response of the system and sketch it.

(b) determine the output y[n] of the system when the input is x[n]=u[n].

(c) Determine the output of the system when the input is a complex exponential (E.g. x[n]=2*exp(j0.26n)).

2. Question on design of simple digital filter using the relationship between pole and zeros and the frequency response of the system.

Design a simple digital FIR filter with real coefficient to remove a narrowband i.e., sinusoidal) disturbance with frequency fo=50Hz. Let fs=300Hz be the sampling frequency.

(a) Determine the desired zeros and poles of the filter.

(b) Determine the filter coefficients with the gain K=1.

(c) Sketch the magnitude of the frequency response.

3. Question on simple digital filtering using the relationship between pole and zeros and the frequency response of the system.

Design an IIR filter with real coefficient with same specifications mentioned in Q2 and repeat the steps (a) to (c).

4. Question to understand the effect of time domain windowing

Generate a signal with two frequencies x(t)=3 Cos(2Pi f1*t)+2 Cos(2Pi f2*t)sampled at fs=8kHz. Let f1=1kHz and f2=f1+'A" and the overall data length be N=256points.

(a) From theory, determine the minimum value of 'A' necessary to distinguish between the two frequencies.

(b) Verify this result experimentally, Using the rectangular window, look at the DFT with several values of 'A' so that you verify the resolution.

(c) repeat part (b0 using a hamming window. How did the resolution change?

5. Comparison of DFT and DCT (in terms of energy compactness)

Generate the sequence x[n]=n-64 for n=0, ...127.

(a) Let X[k] = DFT{x[n]}. For various values of l, set to zero "high frequency coefficients" X[64-l]= ....X[64]= ......X[64+L]=0 and take the inverse DFT. Plot the results.

(b) Let XDCT[k]=DCT(X[n]). For the same values of L, set to zero "high frequency coefficient" XDCT [127-L]= ....XDCT[127]. Take the inverse DCT for each case and compare the reconstruction with the previous case.

6. Filter design:

design a discrete low pass filter with the specification given below:

Sampling frequency =2kHz

Passband edge = 260Hz.

Stop band edge = 340Hz

Max. pass band attenuation=0.1dB.

minimum stop band attenuation = 30dB.

Use the following design methodologies:

Hamming windowing

Kaiser windowing,

Applying bilinear transformation to a suitable Butterworth filter. Compare the obtained filters in terms of performance (accuracy in meeting specifications) and computational complexity).

List of experiments to be done using the DSP processor

1. Write an ALP to obtain the response of a system using linear convolution whose input and impulse response are specified.

2. Write an ALP to obtain the impulse response of the given system, given the difference equation.

2. Sampling of an Image.

3. Design of equiripple filters.

4. Applications of frequency transformation in filter design.

5. Computation of FFT when N is not a power of 2.

6. Sampling rate conversion and plot of spectrum.

7. Analysis of signals by STFT and WT

8. Delayed auditory feedback signal using 6713 processor.

9. Record of machinery noise like fan or blower or diesel generator and obtaining its spectrum.

10Synthesis of select dual tone multi frequency using 6713 processor.

11 Fourier Transform and its inverse Fourier transform of an Image.

Error control coding

Subject Code	: 14ECS41	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction to algebra: Groups, FiECSs, binary fiECS arithmetic, Construction of Galois FiECS GF (2m) and its properties, Computation using Galois filed GF (2m) arithmetic, Vector spaces and Matrices.

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, decoding circuits, Hamming codes, Reed-Muller codes. Golay codes, Product codes and interleaved codes.

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding using multiplication circuits, Systematic cyclic codes - Encoding using feedback shift register circuits, generator matrix for cyclic code, Syndrome computing and error detection, Meggitt decoder, Error trapping decoding, Cyclic hamming codes, Golay code, Shortened cyclic codes.

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois fiECS arithmetic, Implementation of error correction.

Non-binary BCH codes: q-ary linear block codes, Primitive BCH codes over GF(q), Reed -Solomon codes, decoding of non-binary BCH and RS codes: The Berlekamp - Massey Algorithm.

Majority Logic decodable codes: One -step majority logic decoding, One-step majority logic decodable codes, Two-step majority logic decoding, Multiple-step majority logic decoding.

Convolution codes: Encoding of convolutional codes, Structural properties, Distance properties, Viterbi decoding algorithm for decoding, Soft output Viterbi algorithm, Stack and Fano sequential decoding algorithms, Majority logic decoding.

Concatenated codes and Turbo codes: Single level concatenated codes, Multilevel concatenated codes, Soft decision multistage decoding, Concatenated coding schemes with convolutional inner codes, Introduction to Turbo coding and their distance properties, design of Turbo codes.

Burst - error - Correcting codes: Burst and random error correcting codes, Concept of interleaving, Cyclic codes for burst error correction - Fire codes, Convolutional codes for burst error correction

Reference books:

1. Shu Lin and Daniel J. Costello. Jr, "Error control coding", Pearson, Prentice Hall, 2nd edition, 2004.

2. Blahut. R. E, "Theory and practice of error control codes", Addison Wesley, 1984.

RF MEMS

Subject Code	: 14ECS421	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Review: Introduction to MEMS: Fabrication for MEMS transducers and actuators, Microsensing for MEMS, Materials for MEMS.

MEMES materials and fabrication techniques: Metals, Semiconductors, Thin films, Material s for polymer MEMS, Bulk machining for Silicon based MEMS, Surface machining for Silicon based MEMS, Micro stereo-lithography for polymer MEMS.

RF MEMS Switches and micro-relays: Switch parameters, Basics of switching, Switches for RF and Microwave applications, Actuation mechanisms, Micro-relays and micro-actuators, Dynamic of switch operations, MEMS switch design and design consideration, MEMS inductors and capacitors.

Micro machined RF filters and phase shifters: RF filters, Modelling of mechanical filters, Micro-mechanical filters, SAW filters - Basic, Design consideration. Bulk acoustic wave filters, Micro-machined filters for millimetre wave frequencies. Micro-machined phase shifters, Types and limitations, MEMS and Ferroelectric phase shifters, Application.

Micromachined transmission line and components: Micromachined transmission line: Losses in transmission line, coplanar lines, MicroshiECS and membrane supported lines, MicroshiECS components, Micromachined waveguides, Directional couplers and Mixers, Resonators and Filters.

Micromachined antennas: design, Fabrication and measurements, Integration and packaging for RF MEMS, Roles and types of packages, Flipchip techniques, Multichip module packaging and Wafer bonding, Reliability issues and thermal issues.

Reference books:

1. V. K. Varadan, A. Laktakia, and K. J. Vinoy, **"RF MEMS",** John Wiley, 2003 reprint.

2. J De Los Santos, **“RF MEMS circuit design",** Artech House, 2002.

3. Frank Ghenassia, **"Transaction Level Modelling with System C: TLM concepts and applications for Embedded Systems"**, Springer, 2005.

4. Luca Beninid, **"Networks on chips: Technology and Tools",** Morgan Kaufmann Publishers, 2006.

Advanced Computer Networks

Subject Code	: 14ECS422	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction: Computer network, Telephone networks, Networking principles.

Multiple access: Multiplexing - FDM, TDM, SM.

Local Area networks: Ethernet, Token ring, FDDI, Switching - Circuit switching, Packet switching, Multicasting.

Scheduling: Performance bounds, Best effort disciplines, Naming and addressing, Protocol stack, SONET, SDH.

ATM Networks: AAL, Virtual circuits, SSCOP, Internet - Addressing, Routing, Endpoint control.

Internet Protocol: IP, TCP, UDP, ICMP, HTTP.

Traffic management: Models, Classes, Scheduling.

Control of Networks: QoS, Static and dynamic routing, Markov chains, Queuing models, Bellman Ford and Dijkstra's algorithm, Window and rate congestion control, Large deviations of a queue and network, Open and closed loop flow control, Control of ATM networks.

Reference books:

1. J. Walrand and P. Varaya, **"High performance communication networks",** Harcourt Asia (Morgan Kaufmann), 2000.

2. S. Keshav, **"An Engineering approach to Computer Networking",** Pearson Education, 1997.

3. A. Leon-Garcia, and I. Widjaja, **"Communication network: Fundamental concepts and key architectures",** TMH, 2000.

4. J. F. Kurose, and K. W. Ross, **"Computer networking: A top down approach featuring the Internet",** Pearson Education, 2001.

Advances in VLSI Design

Subject Code	: 14ECS423	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Review of MOS circuits: MOS and CMOS static plots, Switches, Comparison between CMOS and BiCMOS.

MESFETs: MESFET and MODFET operations, Quantitative description of MESFETs.

MIS structure and MOSFETS: MIS systems in equilibrium, Under bias, Small signal operation of MESFETs and MOSFETs.

Short channel effects and challenges to CMOS: Short channel effects, Scaling theory, Processing challenges to further CMOS miniaturization.

Beyond CMOS: Evolutionary advances beyond CMOS, Carbon nano-tubes, Conventional v/s tactile computing, Computing, Molecular and biological computing Mole-electronics - Molecular Diode and diode-diode logic. Defect tolerant computing.

Super Buffers, BiCMOS and Steering Logic: Introduction, RC delay lines, Super buffers- An NMOS super buffer, tristate super buffer and pad drivers, CMOS super buffers, Dynamic ratio less inverters, Large capacitive loads, Pass logic, Designing of transistor logic, General functional blocks - NMOS and CMOS functional blocks.

Special Circuit Layout and Technology mapping: Introduction, Talley circuits, NAND-NAND, NOR-NOR, AOI logic, NMOS, CMOS multiplexers, Barrel shifters, Wire routing and module layout.

System design: CMOS design methods, Structured design methods, Strategies encompassing hierarchy, Regularity, Modularity and Locality, CMOS chip design options, Programmable logic, Programmable inter connect, Programmable structure, Gate arrays, Standard cell approach, Full custom design.

Reference books:

1. Kevin F. Burman, Introduction to Semiconductor device", Cambridge publications.

2. Eugen D. Fabricius, "Introduction to VLSI design" McGraw Hill International publications.

3. D. A. Pucknell, "Basic VLSI Design", PHI publication.

4. Wayne Wolf, "Modern VLSI design", Pearson education, 2nd edition, 2002.

Communication System design using DSP algorithm

Subject Code	: 14ECS424	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction to the course: Digital filters, Discrete time convolution and frequency responses, FIR filters - Using circular buffers to implement FIR filters in C and using DSP hardware, Interfacing C and assembly functions, Linear assembly code and the assembly optimizer. IIR filters - realization and implementation, FFT and power spectrum estimation: DTFT window function, DFT and IDFT, FFT, Using FFT to implement power spectrum.

Analog modulation scheme: Amplitude Modulation - Theory, generation and demodulation of AM, Spectrum of AM signal. Envelope detection and square law detection. Hilbert transform and complex envelope, DSP implementation of amplitude modulation and demodulation.

DSBSC: Theory generation of DSBSC, Demodulation, and demodulation using coherent detection and Costas loop. Implementation of DSBSC using DSP hardware.

SSB: Theory, SSB modulators, Coherent demodulator, Frequency translation, Implementation using DSP hardware.

Frequency modulation: Theory, Single tone FM, Narrow band FM, FM bandwidth, FM demodulation, Discrimination and PLL methods, Implementation using DSP hardware.

Digital Modulation scheme: PRBS, and data scramblers: Generation of PRBS, Self synchronizing data scramblers, Implementation of PRBS and data scramblers. RS-232C protocol and BER tester: The protocol, error rate for binary signalling on the Gaussian noise channels, Three bit error rate tester and implementation.

PAM and QAM: PAM theory, baseband pulse shaping and ISI, Implementation of transmit filter and interpolation filter bank. Simulation and theoretical exercises for PAM, Hardware exercises for PAM.

QAM fundamentals: Basic QAM transmitter, 2 constellation examples, QAM structures using passband shaping filters, Ideal QAM demodulation, QAM experiment. QAM receivers-Clock recovery and other frontend sub-systems. Equalizers and carrier recovery systems.

Experiment for QAM receiver frontend. Adaptive equalizer, Phase splitting, Fractionally spaced equalizer. Decision directed carrier tracking, Blind equalization, Complex cross coupled equalizer and carrier tracking experiment.

Echo cancellation for full duplex modems: Multicarrier modulation, ADSL architecture, Components of simplified ADSL transmitter, A simplified ADSL receiver, Implementing simple ADSL Transmitter and Receiver.

Reference Books:

1. Robert. O. Cristi, **"Modern Digital signal processing",** Cengage Publishers, India, 2003.
2. S. K. Mitra, **"Digital signal processing: A computer based approach",** 3rd edition, TMH, India, 2007.
3. E.C. Ifeachor, and B. W. Jarvis,**"Digital signal processing: A Practitioner's approach",** Second Edition, Pearson Education, India, 2002,
4. Proakis, and Manolakis, **"Digital signal processing"**, 3rd edition, Prentice Hall, 1996.

Advanced Radar Systems

Subject Code	: 14ECS425	IA Marks	: 50
No. of Lecture Hours / Week	: 04	Exam. Hours	: 03
Total No. of Lecture Hours	: 50	Exam. Marks	: 100

Introduction: Range equation, Transmitter and Receiver parameters, and Model, Types of Radars.

Radar Signal transmission: Transmitted waveforms (time and frequency domains), Energy, Radar signal analysis using autocorrelation and Hilbert transform, Pulse compression, Clutter: Properties, reduction, coding and chirp.

Radar antenna: Reflector types, Sidelobe control, Arrays - Array factor and beamwidth, Synthetic aperture, adaptive antennas.

Propagation effects: Multipath, Low altitude, Ionosphere.

Radar Networks: Matched filter response and noise consideration.

Data Processing: FFT, Digital MTI, Tracking, Plot track.

Applications: Secondary surveillance, Multistatic, Over the Horizon, Remote sensing and Meteorological radars.

Reference Book:

1. Meril I. Skolnik, **"Radar handbook"**.
2. M. J. B. Scanlan, **"Modern Radar Techniques**".
3. Peyton Z. Peebles, **"Radar principles",** Wiley Interscience.