Course Structure & Syllabus
of
M. Tech. Programme
in
Electronics & Telecommunication Engineering
with Specialisation
COMMUNICATION SYSTEM ENGINEERING
Academic Year – 2016-17

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, ODISHA
Burla, Sambalpur-68018, Odisha
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DEPARTMENT VISION:

Developing new ideas in the field of communication to enable students to learn new technologies, assimilate appropriate skills and deliver meaningful services to the global society and improve the quality of life by training them with strength of character, leadership and self-attainment.

DEPARTMENT MISSION:

- Imparting futuristic technical education to the students.
- Promoting active role of Industry in student curriculum, projects, R&D and placements. Organizing collaborative academic and non-academic programmes with institutions of national and international repute for all round development of students.
- Organizing National and International seminars and symposium for exchange of innovation, technology and information.
- Expanding curricula to cater to demands of higher studies in internationally acclaimed institutes. Preparing students for promoting self-employment.
- Develop the department as a centre of excellence in the field of VLSI andcommunication technology by promoting research, consultancy and innovation.

CURRICULUM
M.TECH – COMMUNICATION SYSTEM ENGINEERING

Course Code	Subject	L	T	P	C
MEC 3132	Advanced Communication Techniques	3	1	0	4
MEC 3131	Analog VLSI Design	3	1	0	4
MEC 3134	Error Control Coding & Cryptography	3	1	0	4
	Elective-I	3	1	0	4
	Elective-II	3	1	0	4
MEC 3191	TSE Laboratory	0	0	3	2
	Elective Laboratory - I	0	0	3	2
MEC 3193	Seminar -I	0	0	3	2
MEC 3194	Comprehensive Viva Voce-I				2

FIRST SEMESTER

Total = 15 5 9 28

SECOND SEMESTER

Course Code	Subject	L	T	P	C
	Communication Networks & Switching	3	1	0	4
	Mobile Computing	3	1	0	4
	Advanced Wireless Communication	3	1	0	4
	Elective-III	3	1	0	4
	Elective-IV	3	1	0	4
	Elective Laboratory - II	0	0	3	2
	Elective Laboratory - III	0	0	3	2
	Seminar -II	0	0	3	2
	Comprehensive Viva Voce-II				2

Total = 15 5 9 28

THIRD SEMESTER

Course Code	Subject	L	T	P	C
	Dissertation Interim Evaluation				10
	Comprehensive Viva -Voce				3
	Seminar on Dissertation				2

Total= 15

FOURTH SEMESTER

Course Code	Subject	L	T	P	C
	Dissertation Open Defense				5
	Dissertation Final Evaluation				20

Total= 25

Grand Total = 96

ELECTIVE-I/ ELECTIVE-II	**ELECTIVE-III/ ELECTIVE-IV**
AdvancedSignal Processing	Pattern Recognition & Application
Computational Techniques in Microelectronics	Optical and Satellite Communication
Nano Electronics	Multi Resolution Analysis
Advanced Computer Architecture	CMOS RF Circuit Design
Advanced Electromagnetics	Embedded System Design
Digital VLSI Design	Computational Intelligence
Software Defined Radio	Advanced Antenna Technology
Ad Hoc & Wireless Networks	Digital Signal Processor Architectures

ELECTIVE LABORATORY-I/II/III
VLSI Design Laboratory - I
VLSI Design Laboratory - II
Design & Simulation Laboratory
Advanced Simulation Laboratory
Advanced Computation Laboratory
Advanced Communication Laboratory
Advanced Image Processing Laboratory

First Semester

Advanced Communication Techniques

Course Objectives:

- Understanding the band pass modulation and demodulation.
- Understanding of multiple access & spread spectrum concepts..
- To understand the advance concepts of Fading & Synchronisation.

Module-1 **(12 Hours)**

Baseband Demodulation: Signals and Noise, Detection of Binary Signals in Gaussian Noise, Intersymbol Interference, Equalization

Bandpass Modulation and Demodulation: Digital Bandpass Modulation Techniques, Detection of Signals in Gaussian Noise, Coherent Detection, Noncoherent Detection, Complex Envelope, Error Performance for Binary Systems, M-ary Signaling and Performance, Symbol Error Performance for M-ary Systems

Module-2 **(12 Hours)**

Multiplexing and Multiple Access: Allocation of the Communications Resources, Multiple Access, Communications System and Architecture, Access Algorithms, Multiple Access Techniques Employed with INTELSAT, Multiple Access Techniques for Local Area Network

Spread Spectrum Techniques: Spread-Spectrum Overviews, Pseudonoise Sequences, Direct-Sequence, Spread-Spectrum Systems, Frequency Hopping Systems, Synchronization, Jamming Considerations, Commercial Applications, Cellular Systems, Introduction to OFDM

Module-3 **(8 Hours)**

Synchronization: Introduction, Receiver Synchronization, Network Synchronization

Communications Link Analysis: Channel and sources of signal loss, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis, Satellite Repeaters

Module-4 **(8 Hours)**

Fading Channels:

The Challenge of Communicating over Fading Channels, Characterizing, Mobile-Radio Propagation, Signal Time-Spreading, Time Variance of the Channel Caused by Motion Mitigating the Degradation Effects of Fading, Summary of the Key Parameters Characterizing Fading Channels, Applications: Mitigating the Effects of Frequency Selective Fading

Text Book:

(1) Digital Communications – Fundamentals and applications by Bernard sklar, 2nd Edition of Pearson education Publication.

Referrence Books:

(1) Digital Communications, J. G. Proakis, 3rd edition, Mc Graw Hill Publication.
(2) J.G. Proakis, M. Salehi, Communication Systems Engineering, Pearson Education International, 2002
(3) Lee & Moseschmitt, Digital Communication, Springer, 2004.
(4) R. Prasad, OFDM for Wireless Communications Systems, Artech House, 2004

Course Outcomes :

- Understanding various formatting & modulation process.
- Understanding the concepts communication link analysis.
- Understanding of Spread Spectrum Techniques, Fading Channels, etc.

Analog VLSI Design

Course Objectives:

- To understand the static, small signal and large signal modelling of MOS Transistor.
- To understand the operation of different MOS Amplifier and Operational Amplifier.
- To understand the operation of different MOS current mirror circuits and comparators.

MODULE-I10 hours

MOS Device and Modeling: The MOS Transistor, Passive Components- Capacitors and Resistors, Integrated Circuit Layout, CMOS Device Modeling- Simple MOS Large Signal Model, Other MOS Large Signal Model Parameters, Small Signal Model of the MOS Transistor, Computer Simulator Models, Subthreshold MOS Model.

MODULE-II10 hours

Analog CMOS Sub Circuits: MOS Switch, MOS Diode/Active Resistor, MOS Current Sinks and Sources, Current Mirrors- Current Mirror with Beta Helper, Cascode Current Mirror and Wilson Current Mirror, Voltage and Current References, Bandgap Reference, CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers.

MODULE-III10 hours

CMOS Operational Amplifiers: Design of Op-Amps, Compensation of OP-Amps, Design of a Two-Stage OP-Amp, Power Supply Rejection Ratio of Two Stage Op-Amp.

MODULE-IV10 hours

Comparators: Characterization of a Comparator, Two Stage Open Loop Comparators, Discrete Time Comparators. Other Open Loop Comparators, Improving the Performance of Open Loop Comparators.

Text Books:

1. Philip.E. Allen and Douglas.R. Holberg, CMOS Analog Circuit Design, Oxford University Press, Indian 3rd Edition, 2012.
2. Paul.R. Gray, Paul.J. Hurst, S.H. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley India, Fifth Edition, 2010

Referrence Books:

1. R.J. Baker, H. W. Li, D. E. Boyce, CMOS Circuit Design, Layout, and Simulation, PHI, 2002
2. D.A. Johns and K. Martin, Analog Integrated Circuit Design; Wiley Student Edition, 2013
3. B. Razavi; Design of Analog CMOS Integrated Circuits, Tata McGraw-Hill, 2002

Course Outcomes :

- Ability of extract the MOS amplification parameters.
- Design improved CMOS amplifiers and Operational Amplifiers.
- Design improved MOS current mirror circuits and comparators.

Error Control Coding and Cryptography

Course Objectives:

- To address the efficient error free and secure delivery of information using codes.
- To use Channel coding to minimize error effects.

- To understand Modulation & Coding Trade Offs.
- To study and apply cryptographic techniques to make the data secure.

Module-I: (10 Hours)

Reed Solomon Codes – Reed-Solomon Error Probability, Why R-S codes perform well against burst noise, R-S performance as a function of size, redundancy and code rate.

Interleaving and Concatenated Codes- Block interleaving, Convolutional Interleaving, Concatenated Codes

Coding and Interleaving Applied to the Compact Disc, Digital Audio Systems- CIRC encoding, CIRC decoding, Interpolation and muting

Turbo Codes- Turbo code Concepts.

Module-II: (10 Hours)

Modulation & Coding Trade Offs

Goals of the Communications System Designer, Error Probability Plane, Nyquist Minimum Bandwidth, Shannon-Hartley Capacity Theorem, Bandwidth Efficiency Plane, Modulation and Coding Trade-Offs, Defining, Designing, and Evaluating Digital Communication Systems, Bandwidth Efficient modulation, Modulation and Coding for Bandlimited Channels, Trellis-Coded Modulation.

Module-III: (Selected portions from Text Book 3) (10 Hours)

Introduction to Security and Cryptographic Techniques: Introduction, Security Goals, Services and Mechanisms, Techniques (1.1-1.4), Traditional Symmetric Key Ciphers(3.1-3.4), Modern Symmetric Key Ciphers (5.1-5.2).

Brief idea about Data Encryption Standard (DES) (6.1-6.5), International Data Encryption Algorithm (DEA) and Advanced Encryption Standard (AES)(7.1-7.2), Encipherment using Modern Symmetric Key Ciphers(8.1-8.3), Asymmetric Key Cryptography(10.1-10.4).

Module-IV:(10 Hours)

Message Integrity(11.1), Message Authentication(11.3), Hash Function(12.1,12.2,12.4), Digital Signature(13.1-13.4), Entity Authentication(14.1-14.3,14.5), Key Management(15.1-15.5), Security in Email, PGP, S/MIME(16.1-16.3), Brief idea on Transport layer (17.1-17.2) and Network layer security(18.1-18.2), System security(19.4-19.8).

Text Books:

1. Digital Communication-Fundamental Applicaton by Bernard Sklar, 2nd Edition of Pearson education Publication (Module-I and II).
2. Information Theory, Coding and Cryptography by Ranjan Bose, TMH Publication. (Module-I and II).
3. Cryptography and Network Security, B.A. Forouzan & D. Mukhopadhyay, (2/e), McGrawHill Publication, 2012. (Module III and IV).

Reference Books:

1. C.B.Schlegel & L.C.Perez, Trellis and Turbo Coding Wiley,2004.
2. S. Gravano, Introduction to Error Control Codes, Oxford Pubs, 2001.
3. Cryptography and Network Security" by A. Kahate, TMH Publication

Course Outcomes :

- Understand the Reed Solomon Codes, Convolutional Codes and Turbo Codes.
- Defining, Designing and Evaluating Digital Communication Systems.
- Understand basic concepts of cryptography.
- Understand practical applications of cryptography
- Apply the principles of coding and cryptography to communication system.

Elective I/II
Advanced Signal Processing

Course Objectives:

- Analyse the process of Sampling, aliasing and the relationship between discrete and continuous signals
- Review of Fourier transforms, the Z-transform, FIR and IIR filters, and oscillators
- Implementthe Filter design techniques, structures and numerical round-off effects
- Understand the Auto-correlation, cross-correlation, power spectrum estimation techniques, forward and backward Linear prediction
- Analyse Wiener filters, LMS adaptive filters, and applications, Multi-rate signal processing and sub-band transforms.
- Analyse the Time-frequency analysis, the short time Fourier transform, and wavelet transforms.

Module-I: Multirate Digital Signal Processing (10 Hours)

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by rational factor I/D, Filter Design and Implementation for sampling-rate, Multistage implementation of sampling rate conversion, Sampling rate conversion of Band-pass signal, Application of multi rate signal processing: design of phase shifters, Implementation pf narrowband lowpass filters. Implementation of Digital filter banks.

Module-II: Linear prediction and Optimum Linear Filters (10 Hours)

Innovations Representation of a stationary random process, Forward and Backward Linear Prediction, Solution of the normal equations, Properties of the linear prediction error filters, AR lattice and ARMA lattice-ladder filters, Wiener filter for filtering and Prediction: FIR Wiener Filter, Orthogonality, Principle in linear mean-square estimation.

Module-III: Power Spectrum Estimation (15 Hours)

Estimation of spectra from finite-duration observation of signals, Non-parametric method for power spectrum estimation: Bartlett method, Blackman and Turkey method, Parametric method for power estimation: Yuke-Walker method, Burg method, MA model and ARMA model. Higher Order Statics(HOS) Moments, Cumulants, Blind Parameters and Order estimation of MA & ARMA systems- Application of Higher Order Statistics Filter Bank and Subband Filters and its applications

Module-IV: Adaptive Signal Processing (8 Hours)

Least mean square algorithm, Recursive least square algorithm, variants of LMS algorithm: SK-LMS, N-LMS, FX-LMS. Adaptive FIR & IIR filters, Application of adaptive signal processing: System identification, Channel equalization, adaptive noise cancellation, adaptive line enhancer.

Text Books:

1. Digital Signal Processing, Third Edition, Prentice Hall, J.G. Proakis and D.G. Manolakis

2. Adaptive Signal Processing, B. Widrow and Stern
3. Digital Signal Processing, Oppenhein and Schafer.

Course Outcomes :

- Have a more thorough understanding of the relationship between time and frequency domain interpretations and implementations of signal processing algorithms
- Understand and be able to implement adaptive signal processing algorithms based on second order statistics
- Be familiar with some of the most important advanced signal processing techniques, including multi-rate processing and time-frequency analysis techniques.

Computational Techniques in Microelectronics

Course Objectives:

- To address the efficient circuit simulation technique.
- To use different types of moment methods.
- To understand VHDL modelling&physical design.

MODULE-I 10 hours

Linear and Non-Linear Circuit Simulation Techniques- Algorithms and Computational Methods; Transient Analysis; Frequency Domain Analysis.

MODULE-II **10 hours**

Moment Methods; Sensitivity Analysis, Timing Simulation. Numerical Solution of Differential Equations- FEM, FVM and FDM, Grid Generation, Error Estimates, Transient and Small Signal Solutions, Applications to Device and Process Simulation.

MODULE-III **10 hours**

Introduction to VHDL Modeling. Layout Algorithms, Yield Estimation Algorithms. Symbolic Analysis and Synthesis of Analog ICs.

MODULE-IV **10 hours**

Introduction to Physical Design, Part Training Algorithms, Algorithms for Placement and Floor Planning, Global Routing And Detailed Routing.

Text Books:

1. L.O.CHUA AND P.M.LIN "Computer Aided Analysis of Electronics Circuits: Algorithms and Computational Techniques"., Prentice –Hall 1975.
2. L.PALLAGE, R.ROHRER ANDC.VISWESWARAIAH, "Electronics Circuits and Simulation Methods", Mc. Graw Hall, 1995.

Reference Book:

1., NAVEED SHEWANI, "Algorithms for VLSI Physical Design Automation", Kluwer Academic, 1993

Course Outcomes :

- Have a more thorough understanding of the algorithms used in computation.
- Understand and be able to implement FEM, FDM, FVM ,etc.
- Be familiar with some of the most important advanced analysis techniques.

Nano Electronics

Course Objectives:

- Calculate the energy levels of periodic structures and nanostructures.

- Calculate the I-V characteristics of nanoelectronic devices.
- Simulate the magnetoresistance response of 2-dimensional structures.
- Summarise the applications of nanotechnology and nanoelectronics
- Understand the impact of nanoelectronics onto information technology, communication and computer science.

Module-I: (10 Hours)

Introduction: Introduction to Nanoscale Systems, Length Energy and Time Scales, Top Down Approach to Nano Lithography, Spatial Resolution of Optical, Deep Ultraviolet, X-Ray, Electron Beam and Ion Beam Lithography,

Module-II: (10 Hours)

Single Electron Transistors, Coulomb Blockade Effects in Ultra Small Metallic Tunnel Junctions.

Module-III: (10 Hours)

Quantum Mechanics: Quantum Confinement of Electrons in Semiconductor Nano Structures, Two Dimensional Confinement (Quantum Wells), Band Gap Engineering, Epitaxy, Landaeur – Buttiker Formalism for Conduction in Confined Geometries, One Dimensional Confinement, Quantum Point Contacts, Quantum Dots and Bottom Up Approach, Introduction to Quantum Methods for Information Processing.

Module-IV: (10 Hours)

Molecular Techniques: Molecular Electronics, Chemical Self Assembly, Carbon Nano Tubes, Self Assembled Mono Layers, Electromechanical Techniques, Applications in Biological and Chemical Detection, Atomic Scale Characterization Techniques, Scanning Tunneling Microscopy, Atomic Force Microscopy

Text Book:

1. Beenaker and Van Houten, Quantum Transport in Semiconducto Nanostructures in Solid State Physics, Ehernreich and Turnbell, Academic press, 1991

Reference Books:

1. David Ferry, Transport in Nano Structures ,Cambridge University press, 2000
2. Y. Imry, Introduction to Mesoscopic Physics, Oxford University press, 1997
3. S. Dutta, Electron Transport in Mesoscopic Systems, Cambridge University press
4. H. Grabert and M. Devoret, Single Charge Tunneling ,Plenum press, 1992

Course Outcomes :

- Have a more thorough understanding of nano scale electronics & associated phenomena.
- Understand & implement quantum mechanics & its significance.
- Be familiar with some of the most important molecular analysis techniques.

Advanced Computer Architecture

Course Objectives:

- Gain the fundamental knowledge of computer hardware and computer systems, with an emphasis on system design and performance.
- Know the principles underlying systems organisation, issues in computer system design, and contrasting implementations of modern systems.
- Understand the design methodology, processor design, control design, memory organization, system organization, and parallel processing.

- Understand the performance and efficiency in advanced multiple-issue processors and symmetric shared-memory architectures.
- Understand virtual memory and virtual machines, storage systems, RAID, I/O performance, and reliability measures.
- Understand Flynn's classifications such as SISD, SIMD, MISD, MIMD.

MODULE-I (10 lectures) **10 hours**

Parallel Processing**:** Definition, Theory of Parallelism. Parallel Computer Models, Parallelism in Uni-processor computers, Implicit Parallelism vs. explicit parallelism, Levels of parallelism. Soft ware Parallelism, Hardware Parallelism. Conditions of Parallelism: Data and Resource Dependencies, Control Dependence, Resource dependence, Berrnstein's condition, Hardware and software parallelism, Flow dependence, Anti dependence, output dependence, I/O dependence, unknown dependence.

MODULE-II (10 lectures) **10 hours**

Program flow Mechanism: Control flow versus data flow, Demand-driven mechanism, Comparison of flow mechanisms, Dataflow computer Architecture, Static dataflow and dynamic dataflow computer, Communication Latency, grain packing and scheduling in parallel programming environment, program partitioning, fine grain program, coarse grain program graph.

MODULE-III (10 lectures) **10 hours**

Parallel Interconnection Systems: Static and Dynamic Networks, Linear Array, Ring, Star, Tree, Mesh, Systolic Array, Chordal ring, Completely connected network, Cube connected cycles, Torus, K-ary-n cube, Barrel shifter, single stage interconnection network, Multistage Interconnection Networks, Control Structure, Node degree, diameter, Bisection width, symmetric, functionality, Network Latency, Bandwidth, Scalability, Data routing functions:-Permutation, Perfect shuffle exchange, Hypercube Routing function.

Pipelining: Linear pipe line processor, Asynchronous and Synchronous models, speed up, Efficiency, Throughput, Non linear pipe line processor, Instruction pipeline, pipeline hazards and Arithmetic pipeline.

MODULE-IV (10 lectures) **10 hours**

Multiprocessor and multicomputers: Hierarchical bus system, crossbar and multi port memory, cross point switch, Flynn's classification: SISD, SIMD, MISD, MIMD, message passing, Loosely coupled and tightly coupled system. Vector processor, memory hierarchy, CISC scalar processor, RISC scalar processor, Caccess and S-access memory organization. Basic ideas on parallel algorithm, SIMD algorithm for matrix multiplication. Fault-tolerance and reliability, Availability, System Performance attributes of parallel Computers.

Text Books:

1. Advanced Computer Architecture, by Kai Hwang Mc Graw Hill.
2. Introduction to Parallel Computing, 2nd Edition, Pearson Education by AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar.

Reference Books:

1. Computer Architecture – A quantitative approach By J.L Hennessy andD.A.Patterson (Morgan)

2. Computer Architecture and Parallel Processing, by K.Hwang and F.A. Briggs.
Mc Graw Hill, International

Course Outcomes :

- Understand the advanced concepts of computer architecture.
- Exposing the major differentials of RISC and CISC architectural characteristics.
- Investigating modern design structures of Pipelined and Multiprocessors systems.
- Become acquainted with recent computer architectures and I/O devices, as well as thelow-level language required to drive/manage these types of advanced hardware.
- Preparing selected reports that imply some emergent topics supporting material essence.

Advanced Electromagnetics

Course Objectives:

- Develop analytical skills in applied electromagnetics with solid theoretical foundation to design emission, propagation and reception of electromagnetic wave systems.
- Identify, formulate and solve fields, radiation, propagation and scattering of electromagnetic wave problems of real-world applications in a multidisciplinary frame individually or as a member of a group
- Develop the numerical techniques by achieving the ability to combine mathematical tools and physical understanding for time-harmonic electromagnetic field and wave computation.
- Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
- Analyze the nature of electromagnetic wave propagation in guided medium used in microwave applications.

Module-I **12hours**

The Dirac Delta & its representation for infinitesimal dipole, magnetic current & magnetic current density, inadequacies in Maxwell's equations, impossibility of TEM in waveguide, dielectric slab waveguide & its application to optical communication, plasma oscillations & wave propagation in plasma, dielectric resonator

Module-II **12hours**

Huygens's principle, Babinet's principle, holography, correlation between circuit theory & field theory, derivation of circuit relations from field theory, Faraday rotation, Schumann resonance, tropo-scatter propagation, earth as a cavity resonator, scattering & diffraction, bridging the gap between electricity & magnetism using relativity, interaction of fields & matter

Module-III **06hours**

Bioelectromagnetics:
Introduction, the axon, retinal optical fibers, heart dipole field, defibrillators & pacemakers, biological fields, electromagnetic hazards & environment

Module-IV **10hours**

Concept of tensors, Special theory of relativity & its applications in electromagnetics

Text Books:

1. Electromagnetic Waves & Radiating Systems,By Jordan &Balmain, PHI
2. Classical Electrodynamics, By J D Jackson, Wiley

3. Introduction to Electromagnetic Fields, By C. R. Paul, K. W. Whites, Syed A. Nasar, McGraw Hill

4. Maxwell's Equations &The Principles of Electromagnetism, By R. Fitzpatric, Infinity Science Press

5. Concepts of Modern Physics, By A. Beiser, McGraw Hill

Course Outcomes:

- Students can use their conceptual understanding of the electromagnetic laws in order to qualitatively describe the behavior of the solution to the problem.
- Illustrate the most common numerical techniques adopted for the electromagnetic modeling of microwave and millimeter-wave circuits and antennas.
- Use their ability to manage the electromagnetic laws to set up a model and perform the necessary calculations by selecting appropriate methods; making appropriate approximations; implementing computer programs.
- Choose some of the most popular commercial electromagnetic programs and to critically evaluate the numerical results.

Digital VLSI Design

Course Objectives:

- Study the characteristics of MOS as an Inverter.
- Study the behavior of MOS in Combinational circuits.
- Study the behavior of MOS in sequential circuits.

MODULE -I **10 hours**

Introduction to MOSFETs: MOS Inverter, Static and Switching Characteristics, Voltage Transfer characteristics, Noise Margin, Regenerative Property, Power and Energy Consumption, Stick/Layout Diagrams; Issues of Scaling.

MODULE -II **10 hours**

Combinational MOS Logic Circuits: Pass Transistors, Transmission Gates, Primitive Logic Gates; Complex Logic Circuits, Sequential MOS Logic Circuits: Latches and Flip-flops, Dynamic Logic Circuits; Clocking Issues, Rules for Clocking, Performance Analysis, Logical effort.

MODULE -III **10 hours**

CMOS Subsystem Design; Data Path and Array Subsystems: Addition, Subtraction, Comparators, Counters, Coding, Multiplication and Division.

MODULE -IV **10 hours**

SRAM, DRAM, ROM, Serial Access Memory, Content Addressable Memory, Field Programmable Gate Array.

Text Books:

1. Rabey J.M, A. Chandrakasan, and B.Nicolic, Digital Integrated Circuits: A design Perspective, Second Edition, Pearson/PH, 2003 (Cheap Edition).

2.Hodges, David A, Analysis and Design Of Digital Integrated Circuits, In Deep Submicron Technology , Tata McGraw-Hill Education, 2005.

Reference Books:

1. Kang, Sung-Mo, and Yusuf Leblebici. CMOS Digital Integrated Circuits, Tata McGraw-Hill Education, 2003.

2. J.P Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2001

3. R. L. Geiger, P.E. Allen and N.R. Strader, VLSI Techniques for Analog and Digital Circuits, McGraw-Hill, 1990

4. DebaprasadDas , VLSI Design, Oxford Publication.

Course Outcomes:

- Ability of extract the MOS switching parameters.
- Efficient design of combinational circuits.
- Efficient design of sequential circuits.

Software Defined Radio

Course Objectives:

- To understand "Modern Radio Communication System "that can be reconfigured
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy
- access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

Module-I **06hours**

Introduction, Multi Rate Signal Processing

Module-II **09hours**

Digital Generation of Signals

Module-III **09hours**

Analog to Digital and Digital to Analog Conversion, Digital Hardware Choices

Module-IV **16hours**

Object – Oriented Representation of Radios and Network Resources, Case Studies in Software Radio Design

Text Books:

1. Software Radio: A Modern Approach to Radio Engineering, By Jeffrey H. Reed, PEA Publication

2. Software Defined Radio: Enabling Technologies, By Walter Tuttle Bee, Wiley

Course Outcomes:

- Compare SDR with traditional Hardware Radio HDR.
- Implement modern wireless system based on OFDM, MIMO & Smart Antenna .
- Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio .
- Work on open projects and explore their capability to build their own communication system.

Ad hoc and Wireless Networks

Course Objectives:

- Identify and understandthe major issues associated with ad-hoc networks.
- Explore current ad-hoc/sensor technologies by researching key areassuch as protocols, hardware, and applications.
- Explain the constraints of physical layer that affect the design and performance of ad-hoc network.

- Understand why protocols required for wired network may not work for wirednetwork at MAC, Network and Transport Layer.
- Explain the operations and performance of various MAC layer protocols, unicastrouting protocols and transport layer protocols proposed for ad hoc networks.
- Understand security issues and QoS requirements.

Module-I: (10 Hours)

Mobile ad hoc networking; imperatives, challenges and characteristics. Bluetooth networks. Routing approaches. Proactive and reactive protocols.

Module-II: (10 Hours)

Clustering and hierarchical routing. Multipath routing. Security aware routing. Energy efficient communication in ad hoc networks. Measuring energy consumption. Power save protocols.

Module-III: (10 Hours)

Maximum life time routing. Secure routing protocols. Intrusion detection. Security considerations in ad hoc sensor networks. Key management.

Module-IV: (10 Hours)

Characterization of IP traffic. QOS classification. Self similar processes. Statistical analysis of non – real time traffic and real – time services.

Text Books:

1. S.Basagni & M.Conti, Mobile Ad Hoc Networking, Wiley, 2004
2. C.Perkins, Ad Hoc Networking, Addison Wesley, 2000.

Reference Books:

1 C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson, 2004.
2 T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House, 2003.
3. Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley, 2006.

Course Outcomes:

- Describe the unique issues in ad-hoc/sensor networks.
- Describe current technology trends for the implementation anddeployment of wireless ad-hoc/sensor networks.
- Discuss the challenges in designing MAC, routing and transportprotocols for wireless ad-hoc/sensor networks.
- Build and configure a testbed for a sensor network.
- Describe and implement protocols on a sensor testbed network.

Telecommunication System Engineering Laboratory

Course Objectives:

- To understand various simulation methods.
- To simulate different communication models

1. Simulation of White Uniform noise, Gaussian Noise, Colored noise
2 Simulation of Tap Delay Digital Filters
3. Simulation of Adaptive Filters (LMS based)
4. Simulation of Adaptive Channel Equalization – Learning Curves and Bit Error.
5. Simulation of data Compression using DCT
6. Simulation of PCM and TDM

7. Simulation of PSK and DPSK Signal
8. Experiments on Digital Communication Trainers.

Course Outcomes:

- Describe the unique issues in simulation techniques.
- Describe different simulation results of communication filters & other parameters.

2nd Semester

Communication Networks and Switching

Course Objectives:

- To understand the working principles of switching systems from manual and electromechanical systems to stored program control systems.
- To gain knowledge about the telecommunication industry: its services and market.
- Understand the theoretical basis about performance (queuing theory) and operation (multiplexing, switching, routing and signaling).
- To understand latest concepts in practical switching.

Module-I:(10 Hours)

Overview of switching systems, Electronic switching and stored program control systems, Centralized SPC, Availability, Distributed SPC, Enhanced services, Digital switching: time switching, space switching, time and space switches, Switching techniques: Circuit Switching, Message and Packet Switching.

Module-II:(10 Hours)

Computer controlled switching systems: Introduction, Call processing, signal exchange diagram, state transition diagram, hardware configuration, switching system software organization, software classification and interfacing, Maintenance software, call processing software, Administration software, Electronic Exchanges in India.

Module-III:(10 Hours)

Traffic engineering: Traffic pattern, Grade of Service and Blocking probability, Modeling of switching systems: Markov Process, Birth-Death Process.

Telephone network organization: Network management, Network services, various networking plans, types of networks, Routing plan, International numbering plan, National numbering plan, Numbering plan in India, Signaling: in channel signaling, common channel signaling.

Module-IV:(10 Hours)

Overview of ISDN, VPN, VOIP, IP switching

Textbooks:

1. Telecommunication Switching Systems and Networks, by Thiagarajan Viswanathan, PHI.
2. Telecommunication Systems Engineering, R. L. Freeman, 4/e, Wiley publication, 2010

Reference book:

1. Telecommunication Switching and Networks. By P.Gnanasivam, New Age International.

Course Outcome:

- Explain the working principle of switching systems involved in telecommunication switching.
- Design multi stage switching structures involving time and space switching stages
- Analyze basic telecommunication traffic theory.
- Understand Modeling of switching systems.
- Understand concepts of IP switching.

Mobile Computing

Course objectives:

- To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
- To understand the use of transaction and e-commerce principles over such devices to support mobile business concepts.
- To appreciate the social and ethical issues of mobile computing, including privacy.

Module-1 (10 Hours)

Mobile Computing, Mobile Computing Architecture, Mobile System Networks, Mobility Management, Mobile Devices and Systems, Global system for Mobile Communication (GSM) System overview: GSM architecture, Mobility management, Network signaling. Call Handling GPRS system Architecture, GPRS protocol layer.

Module-II (10 hours)

WLANs (Wireless LANs) IEEE 802.11 and IEEE 802.22 standard, CDMA, 3G, 4G, Quality of services in 3G, 4G Standards, QOS in 4G, Databases and Mobile Computing, Mobile IP Network Layer, Mobile Transport Layer.

Module-III (10 hours)

Mobile Internet: Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, Wireless markup Languages (WML), Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies. Wireless Application Protocol –WAP 2.0,Blue tooth enabled Devices Network.

Module-IV (10 hours)

Global Mobile Satellite Systems; Case studies of the IRIDIUM and GLOBALSTAR systems, Wireless Enterprise Networks: Introduction to Virtual Networks, Server-side programming in Java, Pervasive web application architecture.

Text books:

1. “Mobile Computing”, A. K Talukdar, H. Ahmed, R. R Yavagal
2. “Mobile Communication”, Raj Kamal, Oxford UniversityPress
3. “The Wireless Application Protocol”, SandeepSinghal, Pearson

Reference books:

1. “Guide to Designing and Implementing Wireless LANs”, Mark Ciampa,Thomson learning, Vikas Publishing House, 2001.
2. “The Generation Mobile telecommunication systems”, by P. Stavronlakis, Springer Publishers.
3. “Pervasive Computing”, Burkhardt, Pearson.

Course outcomes:

- A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities.
- The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
- A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.

ADVANCED WIRELESS COMMUNICATIONS

Course objectives:

- Understand the cellular concepts to evaluate the signal reception performance in a cellular network.
- Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
- Analyse and design receiver and transmitter diversity techniques.
- Determine the appropriate transceiver design of multi-antenna systems and evaluate the data rate performance.
- Distinguish the major cellular communication standards (1G/2G/3G systems)
- Design wireless communication systems with key 3G (CDMA) and 4G (OFDM) technologies.

Module-I **(10hours)**

Introduction to Wireless Communications, Broadband Wireless Channel Models, Diversity, Equalization and Estimation Techniques and Cellular Communications.

Module-II **(10hours)**

OFDM: Basic principle of Orthogonality, Single vs multicarrier system, OFDM Block Diagram and ITS Explanation, OFDM mathematical representation, Selection Parameters for modulation, Pulse shaping in OFDM Signal and spectral efficiency, windowing in OFDM signal and spectral efficiency, Synchonization in OFDM, Pilot Insertion in OFDM, Amplitude limitations in OFDM, CDMA vs OFDM, Hybrid OFDM and Variants of OFDM.

MIMO: Space Diversity and systems based on space diversity, Smart antenna system and MIMO, MIMO Based system architecture, MIMO exploits Multipath, Space-Time Processing, Antenna considerations for MIMO, MIMO channel modeling, measurement, and Capacity, Cyclic Delay Diversity (CDD), Space-Time coding, Advances and Applications of MIMO, MIMO-OFDM.

Module-III **(10hours)**

Wireless Broadcast Networks: Digital Audio Broadcasting (DAB), Digital Radio Mondiale (DRM), HD Radio Technology, Digital Video Broadcasting (DVB), Direct to Home (DTH).

Wireless Cellular Networks: GSM System, GPRS, EDGE Technology, CDMA-based Digital Cellular Standards, WLL, IMT-2000, Mobile Satellite Communication, 3G, 4G and Beyond.

Wireless Ad-Hoc Networks: Bluetooth, Wi-Fi standards,WiMAX standards, Wireless sensor networks, IEEE 802.15.4 and Zigbee, UWB, IEEE 802.20 and beyond.

Module-IV **(10hours)**

Simulation of communication Systems and Software Defined Radio (SDR): Simulation methodology, Multidisciplinary aspects of simulation, Modelling of system, Deterministic simulation, Stocastic simulation, General steps of simulation, SDR, Need for SDR, General structure of the transceiver for SDR, 3G SDR system architecture, Present and future trends in SDR, Cognitive Radio (CR).

Text book:

(1) Wireless Communication, by Upena Dalal, Oxford University Press.

Referrence books:

(1) Fundamentals of Wireless Communications, By D.Tse and P.Viswanath, Cambridge University Press
(2) Wireless Communications, By A. Goldsmith, Cambridge University Press
(3) MIMO Wireless Communications, By E. Biglieri, Cambridge University Press
(4) Wireless Communications: Principles and Practice, By T. S. Rappaport , Prentice Hall

Course outcomes:

- Characterize the trade-offs among frequency reuse, signal-to-interference ratio, capacity, and spectral efficiency,
- Characterize large-scale path loss and shadowing, small-scale fading in terms of Doppler spectrum, coherence time, power delay profile, and coherence bandwidth
- Analyse the error probabilities for common modulation schemes and the performance of trunked radio systems
- Describe simple equalization schemes
- Characterize TDMA, FDMA and CDMA

ElectiveIII/IV

Pattern Recognition & Application

Course objectives:

- Expose students to advanced concepts of digital image processing
- Understand basic concepts of morphological image processing, thresholding etc.
- Design, analyze and implement algorithms for advanced image analysis like image compression, image segmentation etc.
- Enable students to implement techniques in practical image processing problems.
- Understand pattern recognition theories such as Bayes classifier, Syntactic Recognition of strings.

Module-1 (8 hours)

Morphological Image Processing: Preliminaries, Erosion and Dilation; Erosion, Dilation, Duality; Opening and closing; The Hit and miss Transformation; Some Basic Morphological Algorithms: Boundary Extraction, Hole Filling, Extraction of connected components, convex hull, Thinning, Thickening, Skeletons, pruning, Morphological Reconstruction, Summary of Morphological Operations on binary images. Gray Scale Morphology: Erosion and dilation, opening and closing, some basic gray scale morphological algorithms, gray scale morphological reconstruction.

Module-2 (10 hours)

Point, Line, Edge Detection: detection of isolated points, line detection, edge models, basic edge detection, More advanced technique for edge detection: Marr-Hildreth edge detector, Canny edge detector, Edge linking and boundary detection: Local Processing, Global Processing using Hough transform

Thresholding : foundation, basic global thresholding, optimum global thresholding using Otsu's method, using image smoothing to improve global thresholding, multiple thresholding, variable thresholding, multivariable thresholding.

Module-3 (12 hours)

Image Segmentation: Fundamentals, Region based segmentation: region growing, Region splitting and merging. Segmentation using morphological watersheds: background, dam construction, watershed segmentation algorithm, the use of marker.

Representation and Description: Representation: Boundary (border) following, chain codes, polygonal approximations using minimum-perimeter polygons. Other polygonal approximation approaches, signatures, boundary segments, skeletons, Medial axis transformation. Boundary descriptors: some simple descriptors, shape number, Fourier descriptors, statistical moments. Regional descriptors: some simple descriptors, topological descriptors, texture, moment invariants. Use of principal components for description. Relational descriptors.

Module-4 (10 hours)

Object recognition: patterns and pattern classes. Recognition Based on decision-theoretic methods: Matching: minimum distance classifier, matching by correlation, optimum statistical classifiers: Bayes classifier for Gaussian pattern classes, neural networks: perception for two pattern classes, multilayer neural networks. Structural methods: matching shape numbers, string matching. Syntactic Recognition of Strings, Syntactic Recognition of Tree.

Text Books:

1. Digital Image Processing third edition by R. C. Gonzalez and R. E. Woods Pearson
2. Digital Image Processing Wiley student edition by W. K Pratt.

Reference books:

1. Fundamentals of Electronics Image Processing by Arthur R. Weeks, jr.- PHI
2. Digital Image Processing and analysis by B. Chanda and D. Dutt Majumdar, PHI

Course outcomes:

- Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
- Apply pattern recognition techniques to image processing, document analysis etc.

Optical & Satellite Communication

Course Objectives:

- Provide an overview of optical communication, particularly fiber optics, and deals with both the function of related components and with system performance.
- Facilitate the knowledge about optical fiber sources and transmission techniques
- Enrich the idea of optical fiber networks algorithm such as SONET/SDH and optical CDMA, Transreceiver, semiconductors optical amplifiers, couplers/splicers, wavelength division multiplexers and demultiplexers, filters, isolators and optical switches
- Understand the basics of orbital mechanics, the types of satellite orbits, the location of ground stations, and the look angles from ground stations to the satellite.
- Understand link budget equations to provide sufficient margin for performance
- Understand the different interferences and attenuation mechanisms affecting the satellite link design.

Module-I: Satellite System Technology: (10 hours)

Satellite orbits, Satellite constellation and ISL, orbital parameters, look angle determination, launching procedures. Spacecraft subsystems - Attitude and orbit control, power, TT & C, Communication and antennas. Earth station engineering - Transmitter and receiver, antenna.

Link Design:

Digital satellite link analysis and design for FSS and BSS - link budget and Eb/No calculations. Performance impairments - Noise, interference, propagation effects and frequency considerations.

Module-II: Access Techniques: (10 hours)

FDMA concept- Inter modulation and back off - SPADE system. TDMA concept - Frame and burst structure - Frame acquisition and synchronization - Satellite Switched TDMA system. CDMA concepts - DS and FH System acquisition and Tracking.

Module-III: Digital Transmission Systems:- (10 hours)

Point-to-point Links, coding and error considerations, Noise effects on system performance.

Analog Systems:-

Carrier-to-Noise Ratio, Multichannel Transmission Techniques.

Module-IV: Optical amplifiers and Integrated Optical devices: (10 hours)

Optical amplifiers, Amplifier Noise, System Applications, Wavelength Converters. Integrated Optical devices.

Optical Networks:-

Basic Networks, SONET/SDH, Broadcast-and-Select WDM Networks, Wavelength-Routed Networks, Ultrahigh Capacity Networks.

Text Books:

1. Tri T. Ha, Digital Satellite Communication Systems Engineering, McGraw Hill, 1990.
2. Wilbur L. Pritchard, Henri G. Suyderhoud, and Robert A. Nelson, Satellite Communication System Engineering, 2nd Edn., Pearson Education, New delhi.
3. G. Keiser, Optical Fibre Communications, Mc-Graw-Hill.
4. J.M.Senior, Optical Fibre Communications Principles and Practice, PHI.

Reference Books

1. Pratt and Bostain, Satellite Communication, John Wiley and Sons, 1986.
2. M. Richharia, Mobile Satellite Communications – Principles and Trends, Pearson Education, 2003.
3. Robert.M.Gagliardi, Satellite Communication, CBS Publishers

Course Outcomes:

- Describe the design and use of modern optical communication systems with emphasis on components and network architecture.
- Discuss the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- Explain the various optical sources and optical detectors and their use in the optical communication system.
- Identify the fundamentals of orbital mechanics, the characteristics of common orbits used by Communications and other satellites, and be able to discuss launch methods and technologies
- Analyze the performance of satellite communications systems by calculating an accurate link budget for a satellite or other wireless communications link.
- Describe how analog and digital technologies are used for satellite communications networks and the topologies and applications of those networks.

Multi Resolution Analysis

Course Objectives:

The objective of this course is to cover the basic theory of wavelets, multiresolution analysis, construction of scaling functions, bases, frames and their applications in various scientific problems.

Module I **10 Hours**

FUNDAMENTALS

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

Module II **10 Hours**

MULTI RESOLUTION ANALYSIS

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.

Module III **10 Hours**

CONTINUOUS WAVELET TRANSFORMS

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (DaubechiesCoiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.

Module IV **10 Hours**

DISCRETE WAVELET TRANSFORM

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat'sAlgorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme –Lifting Scheme in Z –Domain.

Text Books:

1. Rao R M and A S Bopardikar, ―Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.

2. L.Prasad&S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

Reference Books:

1. J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" WileyIntersciencePublication,John Wiley & Sons Inc., 1999.

2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.

3. Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.

4. Soman K P and Ramachandran K I, ―Insight into Wavelets from Theory to practice, Prentice Hall, 2004.

Course Outcomes:

- Understand the properties of various scaling functions and their wavelets.
- Understand the properties of multiresolution analysis.
- Construct the scaling functions using infinite product formula and iterative procedure.
- Implement wavelets in various problems like image compression, denoising *etc*.
- Develop critical thinking about shortcomings of the state of the art in image processing.

CMOS RF Circuit Design

Course Objectives:

- The concepts of design and analysis of modern CMOS RF and wireless communication integrated circuits are introduced.
- Students will have an in-depth knowledge of basic concepts in CMOS RF design, scattering parameters, modern integrated circuit technologies, fundamental limitations of speed of operation of transistors, physics of noise, impedance matching, low-noise amplifiers, mixers, oscillators, phase noise and phase locked loops.
- To teach students the fundamentals of analog/mixed-signal (analog & digital) circuit design.
- To prepare students for higher-level courses in analog & RF circuits, and analog-digital conversion.

MODULE-I 08hours

Introduction, Basic concepts in RF Design, Passive RLC networks, Passive IC components

MODULE-II 12hours

High frequency amplifier design, Voltage references & biasing, LNA design, Mixers

MODULE-III 12hours

RF power amplifier, PLL, Oscillators, Synthesizers

MODULE-IV 08hours

Noise, Phase noise, Feedback systems

Text books:

1. The Design of CMOS RF Integrated Circuits, By T. H. Lee, Cambridge University Press
2. RF Microelectronics, By B. Razavi, Pearson

Course Outcomes:

- It is expected that the students be able to apply the concepts and design techniques presented in this course to a wide range of applications including high-speed wireless communications and CMOS RF electronics.
- To discuss design and analysis of filters and amplifiers.
- To understand the working concepts of RF active components.
- To study the operation of mixers and oscillators.

Embedded System Design

Course Objective:

- Students have knowledge about the basic functions of embedded systems.
- Students have knowledge about the applications of embedded systems.
- Students have knowledge about the development of embedded software.

MODULE-I **10 hours**

Introduction: An Embedded System, Processor in The System, Other Hardware MODULEs, Software Embedded into a System, Exemplary Embedded Systems, Embedded System-On-Chip (SOC) and in VLSI Circuit. Devices and Device Drivers: I/O Devices, Timer and Counting Devices, Serial Communication Using The „I2C‟ , „CAN‟ and Advanced I/O Buses between the Networked Multiple Devices, Host System or Computer Parallel Communication between the Networked I/O Multiple Devices Using the ISA, PCI, PCI-X and Advanced Buses, Device Drivers, Parallel Port Device Drivers in a System, Serial Port Device Drivers in a System, Interrupt Servicing (Handling) Mechanism.

MODULE-II **10 hours**

Software and Programming Concept: Processor Selection for an Embedded System, Memory Selection for an Embedded System, Embedded Programming in C++, Embedded Programming in Java, Unified Modelling Language (UML), Multiple Processes and Application, Problem of Sharing Data by Multiple Tasks and Routines, Inter Process Communication.

MODULE-III **10 hours**

Real Time Operating System: Operating System Services, I/O Subsystems, Network Operating Systems, Real-Time and Embedded System Operating Systems, Need of a Well Tested and Debugged Real-Time Operating System (RTOS), Introduction to Mc/OS-II. Case Studies of Programming with RTOS: Case Study of an Embedded System for a Smart Card.

MODULE-IV **10 hours**

Hardware and Software Co-Design: Embedded System Project Management Embedded System Design and Co-Design Issues in System Development Process, Design Cycle in the Development Phase for an Embedded System, Use of Software Tools for Development of Embedded System, Issues in Embedded System Design.

Text books:

1. Ralf Niemann, Kluwer Academic, Hardware Software Co-design of Embedded Systems,
2. Hermann Kopetz, Kluwer Academic, Design Principles of Distributed Embedded Applications,
3. Sriram V. Iyer&Pankaj Gupta, Embedded Real-Time Systems Programming, TMH.

Referance books:

1. Peter MarwedelEmbedded System Design, Springer, 2003
2. Wolf, Embedded System Design,

Course Outcome:

- Able to present the mathematical model of the system.
- Able to develop real-time algorithm for task scheduling.
- Able to work on design and development of protocols related to real-time communication.

Computational Intelligence

Course Objectives:

- To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
- To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
- To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Module-I: (10 Hours)

Introduction to Soft Computing: Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

Fuzzy Sets, Fuzzy Rules and Fuzzy Reasoning: Introduction, Basic definitions and terminology, Set-theoretic operations, MF formulation and parameterization, More on fuzzy union, Intersection and Complement, Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning.

Fuzzy Interference System: Mamdani fuzzy models, Sugeno fuzzy models, Tsukamoto fuzzy models, Other considerations.

Module-II: (10 Hours)

Least Square Method for System Identification: System Identification, Basic of matrix manipulations and calculus, Least-square estimator, Geometric interpretation of LSE, Recursive least-square estimator, Recursive LSE for time varying systems, Statistical properties and maximum likelihood estimator, LSE for nonlinear models.

Derivative based Optimization: Descent methods, Method of Steepest Descent, Newton's method, Step size determination, Conjugate gradient methods, Analysis of quadratic case, Nonlinear least-square problems, Incorporation of stochastic mechanism.

Derivative-free Optimization:
Genetic algorithm simulated annealing, Random search, Downhill simplex search.

Module-III: (10 Hours)

Adaptive Networks: Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: combining steepest descent and LSE.

Supervised Learning Neural Networks: Preceptrons, Adaline, Back propagation multi layer preceptrons, Radial basis function networks.

Learning from Reinforcement: Failure is the surest path to success, Temporal difference learning, The art of dynamic programming, Adaptive heuristic critic, Q-learning, A cost path problem, World modeling, Other network configurations, Reinforcement learning by evolutionary computations.

Module-IV: (10 Hours)

Unsupervised Learning and other Neural Networks: Competitive learning networks, Kohonen self-organizing networks, Learning vector quantization, Hebbian learning, Principal component networks, Hopfield network.

Adaptive Neuro-Fuzzy Inference Systems: ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, ANFIS as universal approximator, Simulation examples, Extensions and advance topics.

Coactive Neuro-Fussy Modeling towards generalized ANFIS: Framework, Neuro functions for adaptive networks, Neuro-Fuzzy spectrum, Analysis of adaptive learning capability.

Text Books:

1. Neuro-Fuzzy and Soft Computing, - J.S.R. Jng, C.T.Sun and E. Mizutani, PHI
2. Neural Networks, Fuzzy Logic and Genetic Algorithms, S. Rajasekaran, G.A.Vijayalaksmi, PHI.

Course Outcomes:

- An understanding of fundamental computational intelligence and machine learning models.
- Implemented neural networks, genetic algorithms, and other computational intelligence and machine learning algorithms.
- Applied computational intelligence and machine learning techniques to classification, prediction, pattern recognition, and optimization problems.

Advanced Antenna Technology

Course Objectives:

- To provide comprehensive knowledge of different design and performance parameters of antenna.
- To provide the overall idea about various existing antennas and different advance antennas

presently in practice.
- To provide principle of operation, analysis and application of different antennas such as micro-strip antenna, smart antenna, etc.

Module-I **08hours**

Biconical antenna, discone& conical skirt monopole, equiangular spiral antenna, fractal antenna concept & technology, corrugated horn antenna, multimode horn antenna, smart antenna-benefit, drawbacks & design, adaptive beamforming, MANET, array theory, Electrically small & big antenna

Module-II **08hours**

Artificial dielectric lens antenna, Luneburg & Einstein lenses, electrically & physically small antenna, ground plane antenna, sleeve antenna, turnstile antenna, submerged antenna, surface wave & leaky wave antenna, weather-vane antenna, flagpote antenna, chimney antenna, ILS antenna, sugar-scoop antenna, asteroid detection antenna, embedded antenna, plasma antenna

Module-III **10hours**

Microstrip and other planar antennas, Various types of feeding methods for microstrip antenna (Co-axial, Inset, Aperture/Slot Coupled, Proximity coupled and Corporate feeding for Arrays); Analysis of rectangular Patch Antenna, Cavity/ Modal Expansion Technique, microstrip antenna array

Module-IV **14hours**

Conventional Scanning Techniques, Feed Networks for phased Arrays, Frequency Scanned Array Design, Search Patterns.

Text Books:

1. Antennas Theory – Analysis and Design, By C. Balanis, Wiley India Edition
2. Antennas, By J. D. Kraus & others, McGraw Hill-Special Indian Edition
3. Phased Array Antennas, By A. A. Ollinerand G.H. Knittel,Artech House

Course Outcomes:

- It provides career path to get into different antenna manufacturing industry such as Linx technology, Wavelin Inc. etc.
- It provides an active participation in the electronics industry where advance antennas are essential equipment such as Samsung, Apple etc.
- It provides an opportunity to serve as a faculty in RF & Microwave Engineering

Digital Signal Processor Architecture

Course Objective:

- The objective is to learn DSP Architecture, digital filters, power estimation technique in DSP, advanced architectures and processor of DSP.
- To give an exposure to the various fixed point & a floating point DSP architectures and to develop applications using these processors.
- To give students practice in applying DSP theory to real-world situations, and DSP programming experience.

MODULE-I **10 hours**

Introduction: A Digital Signal-Processing System, Analysis and Design Tool for DSP Systems, Computational Accuracy in DSP Implementations: Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementations, A/D Conversion Errors, DSP Computational Errors, D/A Conversion Errors.

MODULE-II **10 hours**

Architecture for Programmable DSP Devices: Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Module, Programmability and Program Execution, Speed Issues, Features for External Interfacing, Execution Control and Pipelining: Hardware Looping, Interrupts, Stacks, Relative Branch Support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching Effects, Interrupt Effects, Pipeline Programming Models

MODULE-III **10 hours**

Programmable Digital Signal Processors: Commercial Digital Signal-Processing Devices, Data Addressing Modes of TMS320C54XX Processors, Memory Space of TMS320C54XX Processors, Program Control, TMS320C54XX Instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

MODULE-IV10 hours

The Q-Notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit- Reversed Index Generation, An 8-Point FFT Implementation on The TMS320C54XX, Computation of The Signal Spectrum. Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA).A Multichannel Buffered Serial Port (MCBSP), MCBSP Programming, A CODEC Interface Circuit, CODEC Programming, A CODEC-DSP Interface Example.

Text books:

1. Singh, A. and Srinivasan, S., “Programmable DSP Architecture and Applications”Thomson, 2004.
2. Lapsley, P. etal , “DSP Processor Fundamentals: Architectures and Features”, IEEE Press, 1997
3. SenM.kuo, Woon-Seng S. Gan“Digital Signal Processors Architecture, Implementations and Applications”, Pearson,2013

Referance books:

1. Bateman, A. and Yates, W. "Digital Signal Processing Design", Computer Science Press, 1989.
2. Texas Instrument "Digital Signal Processing Applications with the TMS320 Family", Prentice-Hall, 1988.
3. Texas Instruments, "Linear Circuits: Data Conversion, DSP Analog Interface, and Video Interface", 1992.

Course Outcome:

- Describe the specific architecture of the DSP processor used in this class, and understand the architecture of similar commercially produced DSP processors.
- Discussvarious issues that need to be addressed when implementing DSP algorithms in real hardware with finite resources such as processing speed, memory, and bit resolution.
- Write assembler code to implement basic DSP algorithms such as linear filtering with FIR and IIR filters.

Elective Laboratory-I/II/III

VLSI Design Laboratory I

Course Objective:

- Aims at designing various analog & digital VLSI circuits.
- Aims at familiarisation with various VLSI related software.

1. Design of different Current mirror circuits
2. Design of Reference Circuits
3. Design of Amplifiers
4. Design of Differential Amplifiers
5. Design of CMOS OP-AMP
6. Design of Comparators
7. Design of flash ADC
8. Design of SAR ADC
9. Design of Switch Capacitor Filter
10. Implementation of VCO by Ring Oscillator design
11. Design of DPLL
12. Design of ADPLL

Course Outcome:

- Students can design current mirror, amplifiers, OPAMPs, etc. using software.
- They can also analyze ADC, DAC, DPLL , etc.

VLSI Design Laboratory II

(The Following Experiments Need to be Carried out Using HDL Simulation Tools)

Course Objective:

- Students will be familiar with digital VLSI circuits using software.
- They can also analyze various types of VLSI modelling techniques.

1. Design a full adder using dataflow modelling.
2. Design a full adder using half-adder.
3. Design a half adder.
4. Design a 4-bit adder -cum-sub tractor using:

4:1 MUX using the following:

(a) Dataflow
(b) Using when else
(c) Structural modelling using 2:1 MUX
(d) Behavioural modelling using
(i) Case statement
(ii) If else statement
(e) Mixed style of modelling (use structural, behavioural, dataflow)

5. Design a decoder (3: 8) and Encoder (Gray to Binary).

6. Design a BCD to 7-Segment Decoder.

7. Interface the 2-bit adder with 7-segment display.

8. Design 4-bit Even/Odd parity checker & generator.

9. Design of Flip-Flops:

(a) S-R Flip Flop (b) J-K Flip Flop (c) D Flip Flop (d) T Flip Flop

10. (a) Design of counters:

(i) 4-bit up counter (use asynchronous reset)

(ii) 4-bit down counter (use synchronous reset)

(iii) 4-bit up/down counters

(iv) Decade Counter

(b) Design of Shift Registers:

(i) Serial-in serial-out

(ii) Serial-in parallel-out

(c) Design the following using Generics

(i) Generic Decoder

(ii) Generic Parity

(iii)Detector Generic parity generator

11. Design of a simple Microprocessor Data Path and Control Path using VHDL modelling

Course Outcome:

- Students can design encoder, decoder, parity generator, etc. using software.
- They can also analyze counters, flip flops, data path, etc.

Design & Simulation Laboratory

Course Objective:

- Students will study advanced simulation methods.
- They can also simulatevarious communication as well as electromagnetic systems.

1. Simulation of PCM, DPCM, QAM sytems.

2. Simulation of DM, ADM sytems.

3. Simulation of electrostatics sytems.

4. Simulation of electrodynamic sytems.

5. Simulation of analog & digital VLSI sytems.

Course Outcome:

- Students can conceptualize communication systemusing MATLAB software.
- They can also analyze electromagnetic parameters as well as VLSI parameters.

Advanced Simulation Laboratory

Course Objective:

- Students will study advanced simulation methods.
- They can also analyze Higher Order Statistics.

1. Signal Decomposition using Multi Resolution Techniques.

2. Wavelet Coding Techniques

3. Spectral Estimation Using Parametric Method

4. Higher Order Statistics of a Signal

5. PCA/ICA Analysis

Course Outcome:

- Students can conceptualize multi resolution techniques using MATLAB software.
- They can also analyze spectral estimation methods along with PCA/ICA analysis.

Advanced Computation Laboratory

Course Objectives:

- To provide an environment to bridge theory and experiment.
- To provide an insight to convert mathematical equations into coding language.
- To provide a pictorial representation of mathematical modeling of physical system

1. Simulation of FEM method
2. Simulation of FDM method
3. Simulation of MOM method
4. Simulation of FDTD method
5. Computational complexity & convergence of results comparison of above four methods

Course Outcomes:

- It provides hands on experience on MATLAB coding of numerical methods.
- It provides hands on experience on solving fundamental electromagnetic problems using computational methods.
- It creates an interest to model new high frequency devices.
- It develops awareness for upcoming real world problem and to resolve them.
- It develops the potential to implement the new concepts in the diverse field of interest.

Advanced Communication Laboratory

Course Objectives:

- To verify functions of digital modulation and multiplexing techniques using Matlab for different channel characteristics.
- To get better understanding of digital modulation techniques, microstrip technology and concept of optical fibre communication losses.
- To understand the different advanced modulator techniques and their importance in real time applications .
- Implementation and realization of coding.

A) **Wireless Communication (Any Four)**

1) Simulation of larger scale path loss.
2) Simulation of small scale fading and multi-path (Any one model).
3) Simulation of QPSK transmitter and receiver.
4) Simulation of DS spread spectrum transmitter and receiver.
5) Simulation of channel Equalizer for mobile channel.
6) Simulation of Read-Solomon or Turbo and Trellis codes.

B) **Fiber Optic (Any Four)**

1) Fiber to Fiber Coupling Loss.
2) Measurement of Connector Loss.
3) Fiber bending Loss.
4) Fiber Optic Analog Link.
5) Fiber optic digital ling.

6) Intensity modulated fiber pressure sensor.

Course Outcomes:

- After the completion of the course, student will have hands-on experience that enable the design of digital communication links from transmitter to the receiver in single or multi-channel configurations.
- Understand the clearly the concepts related to Digital Modulation techniques.
- Under the design of digital modulation techniques.
- Understand the various optical fibre communication losses that occur in real time.

Advanced Image Processing Laboratory

Course Objectives:

- To expose students to basic principles and advanced concepts of digital image processing;
- To design and implement algorithms that perform basic image processing operations like filtering of noise and image enhancement;
- To design, analyze and implement algorithms for advanced image analysis like image compression, image reconstruction, image segmentation;
- To enable students to implements solutions for complex image processing problems.
- To learn different types of image enhancement and restoration techniques.

1) Spatial Operations.
2) Frequency domain operations
3) Filtering .
4) Image enhancement.
5) Image compression.
6) Image segmentation.
7) Color image processing.

Course Outcomes:-

- Examine various types of images, intensity transformations and applying various filtering techniques.
- Identify the suitable image enhancement and restoration techniques based upon the application.
- Show how higher-level image concepts such as edge detection, segmentation, representation can be implemented and used.
- To manipulate both binary and grayscale digital images using morphological filters and operators to achieve a desired result.
- Apply image processing algorithms in practical applications.