PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable graduates to possess skills to develop new innovation in the field of Electronics and Communication Engineering using analytical reasoning and state-of-the-art approaches derived from the Engineering Sciences and Engineering practice.
2. To enable graduates to create useful systems, components, or processes through agile, skillful, and innovative analysis and design, while respecting economic, environmental, cultural, and ethical standards or constraints.
3. To enable graduates to engage in lifelong learning, adapt to evolving Technology, work in multidisciplinary research for designing innovative products & solutions and become Entrepreneurs.
4. To enable graduates to acquire technical and managerial leadership positions in their chosen fields.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [K3-APPLY]

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [K4-ANALYZE]

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [K5-EVALUATE]

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.[K5-EVALUATE]

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. [K3/K5-APPLY/EVALUATE]

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.[A2-RESPOND]

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.[A3-VALUING]
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [A3-VALUING]

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [A3-VALUING]

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. [A3-VALUING]

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. [A3-VALUING]

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [A2-RESPOND]

**Program Specific Outcomes (PSOs)**

1. To apply the core aspects of Electronics and Communication Engineering principles such as Signal Processing, Embedded Systems, Networking and Semiconductor Technology for designing Electronic products.

2. To identify and utilize the strengths of current technologies in the Microelectronics, Signal Processing and Communication System domains in implementing ICT enabled services for societal needs.

3. To identify user needs to provide suitable design solutions for implementing Analog & Digital Circuits or Systems for a given specification and function.

Provide mapping of 1) POs to PEOs and 2) PSOs to PEOs. Use the following marking:

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<th>Contribution</th>
<th>1: Reasonable</th>
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MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table.

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MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

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#### SEMESTER II
##### ELECTIVE II

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#### SEMESTER II
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### SEMESTER III
#### ELECTIVE V

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<td>Machine Vision</td>
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OBJECTIVES:
The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

UNIT I  FUZZY LOGIC  12
Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II  MATRIX THEORY  12
Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT III  PROBABILITY AND RANDOM VARIABLES  12

UNIT IV  DYNAMIC PROGRAMMING  12

UNIT V  QUEUEING MODELS  12

TOTAL: 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following skills:

• Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and applications of fuzzy logic.
• Apply various methods in matrix theory to solve system of linear equations.
• Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
• Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming
• Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
• Using discrete time Markov chains to model computer systems.
REFERENCES:

AP5152 ADVANCED DIGITAL SIGNAL PROCESSING L T P C 3 2 0 4

OBJECTIVES:
- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction and filtering concepts and techniques.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9+6

UNIT II SPECTRUM ESTIMATION 9+6

UNIT III LINEAR ESTIMATION AND PREDICTION 9+6

UNIT IV ADAPTIVE FILTERS 9+6
UNIT V  MULTIRATE DIGITAL SIGNAL PROCESSING  


TOTAL 45+30 : 75 PERIODS

OUTCOMES:

- Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
- Explain various noise types, Yule-Walker algorithm, parametric and non-parametric methods, Wiener and Kalman filtering, LMS and RMS algorithms, Levinson-Durbin algorithm, adaptive noise cancellation and adaptive echo cancellation, speed versus convergence issues, channel equalization, sampling rate change, subband coding and wavelet transform.
- Calculate mean, variance, auto-correlation and PSD for WSS stochastic processes, and derive prediction error criterion, Wiener-Hoff equations, Parseval’s theorem, W-K theorem and normal equations.
- Design AR, MA, ARMA models, Weiner filter, anti-aliasing and anti-imaging filters, and develop FIR adaptive filter and poly-phase filter structures.
- Simulate spectral estimation algorithms and basic models on computing platform.

REFERENCES:


AP5092  SOLID STATE DEVICE MODELLING AND SIMULATION  

OBJECTIVES:

- To understand the concept of device modeling
- To learn multistep method
- To study device simulations
UNIT I  MOSFET DEVICE PHYSICS MOSFET
 capacitor, Basic operation, Basic modeling, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling, model parameter extraction, modeling parasitic BJT, Resistors, Capacitors, Inductors.

UNIT II  DEVICE MODELLING
Prime importance of circuit and device simulations in VLSI; Nodal, mesh, modified nodal andhybrid analysis equations. Solution of network equations: Sparse matrix techniques, solution of nonlinear networks through Newton-Raphson technique, convergence and stability.

UNIT III  MULTISTEP METHODS
Solution of stiff systems of equations, adaptation of multistep methods to the solution of electrical networks, general purpose circuit simulators.

UNIT IV  MATHEMATICAL TECHNIQUES DEVICE SimulationS
Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

UNIT V  SIMULATION OF DEVICES
Computation of characteristics of simple devices like p-n junction, MOS capacitor and MOSFET; Small-signal analysis.

OUTCOMES:
Upon completion of this course, the students should be able to:
• Explain the importance of MOS Capacitor and Small signal modeling
• Apply and determine the drift diffusion equation and stiff system equation.
• Analyze circuits using parasitic BJT parameters and newton raphson method.
• Model the MOS transistor using schroedinger equation and Multistep methods.

REFERENCES:
CU5151 ADVANCED DIGITAL COMMUNICATION TECHNIQUES L T P C 3 0 0 3

OBJECTIVES:
- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand the different Equalizers.
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the basics of Multicarrier and Multiuser Communications.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION

UNIT II EQUALIZATION TECHNIQUES

UNIT III BLOCK CODED DIGITAL COMMUNICATION
Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon’s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION

UNIT V MULTICARRIER AND MULTIUSER COMMUNICATIONS
Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

OUTCOMES:
Upon Completion of the course, the students will be able to
- Develop the ability to understand the concepts of signal space analysis for coherent and non- coherent receivers.
- Conceptually appreciate different Equalization techniques.
- Possess knowledge on different block codes and convolutional codes.
- Comprehend the generation of OFDM signals and the techniques of multiuser detection.

TOTAL : 45 PERIODS
REFERENCES:

CU5192 OPTICAL NETWORKS

OBJECTIVES:
The students should be made to understand:
- Optical system components like optical amplifiers, wavelength converters.
- Up-to-date survey of development in Optical Network Architectures.
- Packet switching.
- Network design perspectives.
- Different Optical Network management techniques and functions.

UNIT I

UNIT II

UNIT III
UNIT IV

UNIT V
Network topologies and protection schemes: Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS).

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Design and Analyze Network Components
- Assess and Evaluate optical networks

REFERENCES:
2. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson

EL5111  COMMUNICATION AND SIGNAL PROCESSING LABORATORY  L  T  P  C
(SDR platform based)  0  0  4  2

OBJECTIVE
- To develop skills for implementing various modulations, coding and equalization schemes on a SDR platform.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Details of Experiment</th>
<th>Details of Equipment / Instrument Required for a batch of 25 Students</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pulse Shaping, Timing &amp; Frequency Synchronization</td>
<td>Set - PC + SDR Board</td>
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<td></td>
<td>Duration: 4 Hours</td>
<td>Quantity: 12 sets</td>
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<td>2.</td>
<td>BPSK Modulation and Demodulation</td>
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<td>Quantity: 12 sets</td>
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<td>Differential BPSK</td>
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<td>QPSK Modulation and Demodulation</td>
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<td>16-QAM</td>
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<td>6.</td>
<td>LMS based linear Channel Equalization</td>
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<tr>
<td>7.</td>
<td>Decision Feedback Equalizer</td>
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<td>8.</td>
<td>Mini Project</td>
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<td></td>
<td>Duration: 4 Hours</td>
<td>Quantity: 12 sets</td>
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TOTAL: 60 PERIODS
OUTCOMES
- To be able to design and implement synchronization schemes for communication system.
- To be able to design and implement equalization schemes.
- To be able to design and implement various digital modulation schemes.
- To be able to use SDR platform for design of communication systems.

AP5252 \hspace{2cm} \textbf{ASIC AND FPGA DESIGN} \hspace{2cm} \textbf{L T P C}
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\end{align*}

OBJECTIVES:
- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I \hspace{2cm} \textbf{OVERVIEW OF ASIC AND PLD} \hspace{2cm} 9
Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

UNIT II \hspace{2cm} \textbf{ASIC PHYSICAL DESIGN} \hspace{2cm} 9
System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT III \hspace{2cm} \textbf{LOGIC SYNTHESIS, SIMULATION AND TESTING} \hspace{2cm} 9

UNIT IV \hspace{2cm} \textbf{FIELD PROGRAMMABLE GATE ARRAYS} \hspace{2cm} 9

UNIT V \hspace{2cm} \textbf{SOC DESIGN} \hspace{2cm} 9

TOTAL : 45 PERIODS

OUTCOMES:
- To analyze the synthesis, Simulation and testing of systems.
- To apply different high performance algorithms in ASICs.
- To discuss the design issues of SOC.
REFERENCES:

AP5073 RF SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:
• The CMOS RF Front End (RFE) is a very crucial building block and in all of wireless and many high frequency wire-line systems. The RFE has few important building blocks within ii including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, Power Amplifiers, and impedance matching circuits.
• The present course will introduce the principles of operation and design principles associated with these important blocks.
• The course will also provide and highlight the appropriate digital communication related design objectives and constraints associated with the RFEs

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES
Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct upconversion Transmitter, Two step upconversion Transmitter.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS
S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS
Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

UNIT IV MIXERS AND OSCILLATORS
Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, subsampling mixers, Oscillators describing Functions, Colpitts oscillators Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.
UNIT V  PLL AND FREQUENCY SYNTHESIZERS  
Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

TOTAL : 45 PERIODS

OUTCOMES:
- The student after completing this course must be able to translate the top level wireless communications system specifications into block level specifications of the RFE.
- The student should be also able to carry out transistor level design of the entire RFE.

REFERENCES:
5. Recorded lectures and notes available at . http://www.ee.iitm.ac.in/~ani/ee6240

EL5201  WIRELESS COMMUNICATION AND NETWORKING  
OBJECTIVES:
- To understand the characteristics of wireless channels and the fundamental limits on the capacity of wireless channels
- Understand various types of local area networks, WiMax and wide area networks.
- Understand various wireless networking standards such as 3G and 4G.
- To interwork between WLAN and WWAN.
- To have a good understanding of emerging wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

UNIT I  THE WIRELESS CHANNEL  
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II  3G EVOLUTIONS  
UNIT III 4G AND BEYOND
Introduction to LTE – Requirements and Challenges, network architectures – EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV ADHOC & SENSOR NETWORKS
Introduction to WLAN – IEEE 802.11 and HIPERLAN, Bluetooth, WiMAX. Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks - Classification, MAC and Routing protocols.

UNIT V INTERWORKING CONCEPTS AND COOPERATIVE WIRELESS NETWORKS
Interworking objectives and requirements, Schemes to connect WLANs and 3G Networks, Session Mobility, Interworking Architectures for WLAN and GPRS. Introduction to User cooperation and cognitive systems - Relay channels - A general three node relay channel - Wireless relay channel - User cooperation in wireless networks - Two user cooperative network

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, student will be able to
- Understand the concepts of wireless LAN, WAN and various wireless standards.
- Work with different wireless networks.
- Familiarize with advanced wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

REFERENCES:
OBJECTIVES:
- To understand how transistor as Nano device
- To understand various forms of Nano Devices
- To understand the Nano Sensors

UNIT I  SEMICONDUCTOR NANO DEVICES  9
Single-Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor - Single-Electron Transistors; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers: Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA-Based Nanodevices; Gas-Based Nanodevices.

UNIT II  ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS  9

UNIT III  THERMAL SENSORS  9
Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

UNIT IV  GAS SENSOR MATERIALS  9
Criteria for the choice of materials - Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity; Discussion of sensors for various gases, Gas sensors based on semiconductor devices.

UNIT V  BIOSENSORS  9
Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications - fabrication of biosensors - future potential.

OUTCOMES:
- To be able to simulate and design the nano device
- To be able to simulate and design the nano sensors

REFERENCES:
OBJECTIVES:
- To study of 32 bit ARM7 microcontroller RTOS
- To learn modeling of sequential digital system using Verilog and VHDL
- To study designing of wireless network using embedded systems
- To understand system design using ASIC

1. Study of 32 bit ARM7 microcontroller RTOS and its application
2. Testing RTOS environment and system programming
3. Designing of wireless network using embedded systems
4. Implementation of ARM with FPGA
5. Design and Implementation of ALU in FPGA using VHDL and Verilog
6. Modeling of Sequential Digital system using Verilog and VHDL
7. Flash controller programming - data flash with erase, verify and fusing
8. System design using ASIC

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students should be able to:
- Analyze testing RTOS environment and system programming
- Demonstrate Implementation of ARM with FPGA
- Explain flash controller programming
- Discuss design and implementation of ALU in FPGA using VHDL and Verilog
UNIT II ROUTING IN AD HOC NETWORKS

UNIT III MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS

UNIT IV SENSOR MANAGEMENT

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students should be able to:
  • Identify different issues in wireless ad hoc and sensor networks.
  • To analyze protocols developed for ad hoc and sensor networks.
  • To identify and address the security threats in ad hoc and sensor networks.
  • Establish a Sensor network environment for different type of applications.

REFERENCES:
OBJECTIVES:
- To familiarize about the features, specification and features of modern microprocessors.
- To gain knowledge about the architecture of Intel 32 and 64 bit microprocessors and salient features associated with them.
- To familiarize about the features, specification and features of modern microcontrollers.
- To gain knowledge about the 32 bit microcontrollers based on ARM and PIC32 architectures.

UNIT I FEATURES OF MODERN MICROPROCESSORS

UNIT I HIGH PERFORMANCE CISC ARCHITECTURES
Introduction to IA 32 bit architecture – Intel Pentium Processors family tree – Memory Management – Branch prediction logic - Superscalar architecture – Hyper threading technology – 64 bit extension technology – Intel 64 bit architecture - Intel Core processor family tree – Turbo boost technology – Smart cache - features of Nehalem microarchitecture.

UNIT II HIGH PERFORMANCE RISC ARCHITECTURE - ARM

UNIT III FEATURES OF MODERN MICROPROCESSORS

UNIT IV HIGH PERFORMANCE MICROCONTROLLER ARCHITECTURES
Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture for microcontrollers – Thumb 2 instruction technology – Internal Registers - Nested Vectored Interrupt controller - Memory map - Interrupts and exception handling – Applications of Cotex-M3 architecture.

TOTAL: 45 PERIODS

OUTCOMES:
After completion of the course, the students should be able
- To explain the features and important specifications of modern microprocessors.
- To explain the salient features CISC microprocessors based on IA-32 bit and IA-64 bit architectures.
- To explain the salient features RISC processors based on ARM architecture and different application profiles of ARM core.
- To explain the features and important specifications of modern microcontrollers.
- To explain about ARM – M3 architecture and its salient features.
REFERENCES:

MP5092 SOFT COMPUTING TECHNIQUES

OBJECTIVES:
- To know the basics of artificial neural networks
- To provide adequate knowledge about feed forward /feedback neural networks
- To apply the concept of fuzzy logic in various systems.
- To have the idea about genetic algorithm
- To provide adequate knowledge about the applications of Soft Computing.

UNIT I ARTIFICIAL NEURAL NETWORK

UNIT II FUZZY LOGIC

UNIT III NEURO-FUZZY MODELLING
ANFIS Architecture-Classification and Regression Trees-Data Clustering algorithms-Rulebase Structure Identification.

UNIT IV GENETIC ALGORITHMS

UNIT V APPLICATIONS OF SOFTCOMPUTING

TOTAL : 45 PERIODS

OUTCOMES:
- Knowledge on concepts of soft computational techniques.
- Able to apply soft computational techniques to solve various problems.
- Motivate to solve research oriented problems.
REFERENCES:

OBJECTIVES:
- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I  SIGNAL PROPAGATION ON TRANSMISSION LINES
Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance, wave propagation, reflection, and bounce diagrams Reactive terminations – L, C, static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching, input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion

UNIT II  MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK
Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits, S-parameters, Lossy and Lossless models

UNIT III  NON-IDEAL EFFECTS
Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, tanδ, routing parasitic, Common-mode current, differential-mode current, Connectors

UNIT IV  POWER CONSIDERATIONS AND SYSTEM DESIGN
SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis
UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

OUTCOMES:
- Ability to identify sources affecting the speed of digital circuits.
- Able to improve the signal transmission characteristics.

REFERENCES:

TOOLS REQUIRED
1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html

EL5002 OPTICAL SENSORS AND APPLICATIONS

OBJECTIVES:
- To understand the basic concept of optics for different parameters measurement
- To learn the principle of optical sensing,
- To know the fundamental of integrated optical sensing elements and accessories

UNIT I INTRODUCTION
Optics for differential sensing of temperature, humidity and pressure; detection of bio-molecules, gases and chemicals; measurements of displacement, vibration and thickness of transparent thin-films; inertial navigation – position, velocity, acceleration, and rotational sensing; structural health monitoring; scanning and infrared imaging, etc.

UNIT II PRINCIPLE OF OPTICAL SENSING
Fluorescence & Absorption Spectroscopy, Polarization/Amplitude/Intensity Modulation, Cavity Resonances & Sagnac Effect, Distributed Scattering Effects (Bragg, Raman & Brillouin).

UNIT III INTEGRATED OPTICAL SENSING ELEMENTS & ACCESSORIES
Dielectric and Plasmonic Waveguides, Microbridge / Suspended Waveguide and Waveguide cantilever, Passive and Active Phase Shifters, Quantum Dot Photodetectors, Dielectric Mirror & Antireflection Coating, Membrane / Diaphragm, Microfluidic Channels, and Micropumps.

UNIT IV INTEGRATED OPTICAL MULTI-FUNCTIONAL SENSOR DEVICES
Surface Plasmon Polariton Resonators, Vertical and In-Plane Fabry-Perot Interferometer, Mach-Zehnder Interferometers, Coupled Microring Resonator(s), Lab-on-Chip.
UNIT V  APPLICATION SPECIFIC OPTICAL SENSOR SYSTEMS  
Integrated Fiber Optic Gyro (IFOG), Optical Time Domain Reflectometer (OTDR), Light Detection and Ranging (LIDAR), Optical Scanners, IR Camera and Photodetector Array.

OUTCOMES:
After completing this course the student,
- To utilize integrated optical multifunctional sensor devices
- To discuss different applications of sensor systems

REFERENCES:

ADVANCED DIGITAL IMAGE PROCESSING

OBJECTIVES:
- To understand the image fundamentals.
- To understand the various image segmentation techniques.
- To extract features for image analysis.
- To introduce the concepts of image registration and image fusion.
- To illustrate 3D image visualization.

UNIT I  FUNDAMENTALS OF DIGITAL IMAGE PROCESSING  
Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, SVD. Image enhancement in spatial and frequency domain, Review of Morphological image processing.

UNIT II  SEGMENTATION  
Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.
UNIT III FEATURE EXTRACTION
First and second order edge detection operators, Phase congruency, Localized feature extraction - detecting image curvature, shape features, Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION

UNIT V 3D IMAGE VISUALIZATION
Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon Completion of the course, the students will be able to
- Explain the fundamentals digital image processing.
- Describe image various segmentation and feature extraction techniques for image analysis.
- Discuss the concepts of image registration and fusion.
- Explain 3D image visualization.

REFERENCES:
MU5091 MULTIMEDIA COMPRESSION TECHNIQUES  
3 0 0 3

OBJECTIVES:
- To understand the basic ideas of compression algorithms related to multimedia components – Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis on underlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications
- To understand and implement compression standards in detail.

UNIT I FUNDAMENTALS OF COMPRESSION  

UNIT II TEXT COMPRESSION  

UNIT III IMAGE COMPRESSION  

UNIT IV AUDIO COMPRESSION  

UNIT V VIDEO COMPRESSION  

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students should be able to
- Implement basic compression algorithms with MATLAB and its equivalent open source environments.
- Design and implement some basic compression standards
- Critically analyze different approaches of compression algorithms in multimedia related mini projects.
REFERENCES:

CU5191 ADVANCED RADIATION SYSTEMS

OBJECTIVES:
• To understand antenna radiation and its parameters.
• To enhance the student knowledge in the area of various antenna design.
• To design mono pole, dipole and patch antenna and to impart the knowledge about modern antennas.

UNIT I ANTENNA FUNDAMENTALS
Wave equations, radiation pattern, HPBW,FNBW, gain and directivity, polarization, equivalent circuit, radiation resistance, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna, Antenna parameters, Image theory; Induction, reciprocity theorem, Balance to unbalance transformer, Introduction to numerical techniques.

UNIT II RADIATION FROM APERTURES
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture, distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, design considerations.

UNIT III ARRAYS
Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beamforming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retrodirective and self phased arrays.

UNIT IV MICRO STRIP ANTENNA
Radiation mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Applications of microstrip array antenna.

UNIT V SPECIAL ANTENNAS AND MEASUREMENTS
Mobile phone antenna ,base station, hand set antenna, UWB antenna, PIFA, Vivaldi antenna, Antenna for automobiles, Broadband antenna, antenna factor, Gain, impedance and radiation pattern measurements, Test sites and anechoic chamber.

TOTAL : 45 PERIODS
OUTCOMES:

- Ability to understand antenna concepts
- Ability to design antenna for various applications
- Knowledge of modern antenna design

REFERENCES:

UNIT V  CONCURRENT PROCESS MODELS AND HARDWARE SOFTWARE
CO- DESIGN


OUTCOMES:
• To discuss on Hardware software partitioning in system design
• To discuss strategies for processor communications

REFERENCES:
4. Giovanni De Micheli, Rolf Ernst Morgon, “Reading in Hardware/Software Co-Design” Kaufmann Publishers, 2001

CU5292  ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY  LT P C
3 0 0 3

OBJECTIVES:
At the end of the course the student able to learn the concepts of :
• The basics of EMI.
• EMI sources.
• EMI problems.
• Solution methods in PCB.
• Measurements techniques for emission.
• Measurement techniques for immunity.

UNIT I  BASIC THEORY
Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.
UNIT II COUPLING MECHANISM
Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III EMI MITIGATION TECHNIQUES
Working principle of Shielding and Murphy’s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

UNIT IV STANDARD AND REGULATION

UNIT V EMI TEST METHODS AND INSTRUMENTATION
Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of this course, the student should be able to:
- Identify Standards
- Compare EMI test methods
- Discuss EMI mitigation techniques

REFERENCES:
5. Electromagnetic Compatibility by Norman Violette, Published by Springer, 2013
6. Electromagnetic Interference and Compatibility by Donald R. J. White published by Don white consultants Original from the University of Michigan Digitized 6 Dec 2007
EL5004  SMART ANTENNAS  L T P C  3 0 0 3

OBJECTIVES:
- To understand smart antenna environments
- To learn channel models
- To learn algorithms for Multi target decision

UNIT I

UNIT II

UNIT III

UNIT IV
Optimal spatial filtering – adaptive algorithms for CDMA. Multi target decision – directed algorithm.

UNIT V
DOA estimation – conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

TOTAL :45 PERIODS

OUTCOMES:
- To compare algorithms for target decision
- To explain DOA estimation techniques

REFERENCES:

EL5071  BROADBAND ACCESS TECHNOLOGIES  L T P C  3 0 0 3

OBJECTIVES:
- To give fundamental concepts related to broadband access technologies.
- To understand the current and emerging wired and wireless access technologies.
- To acquire knowledge about cable modems and fiber access technologies.
- To have an exposure to different systems standards for next generation broadband access networks.
UNIT I  REVIEW OF ACCESS TECHNOLOGIES
Phone-Line modem, cable-access, ISDN, Emerging Broad band Technologies, Cable DSL, Fiber and Wireless, Standards for access network.

UNIT II  DIGITAL SUBSCRIBER LINES
Asymmetric Digital subscriber lines (ADSL) – Rate Adaptive subscriber line (RADSL)-ISDN Digital subscriber line (IDSL) - High bit rate DSL (HDSL)-Single line DSL (SDSL) - very high bit rate DSL (VDSL) - Standards for XDSL & Comparison.

UNIT III  CABLE MODEM

UNIT IV  FIBER ACCESS TECHNOLOGIES
Optical Fiber in access networks, Architecture and Technologies- Hybrid fiber – Coax (HFC) system, Switched Digital Video (SDV) – Passive optical networks (PON) – FTTX (FTTH, FTTC, FTTB, FTT cab) comparison, Broadband PON, Gigabit-Capable PON.

UNIT V  BROAD BAND WIRELESS
Fixed Wireless, Direct Broadcast Satellite (DBS), Multi channel multi point distribution services (MMDS), Local multi point distribution services (LMDS), and Wideband integrated Digital Interactive Services (WIDIS), Mobile Wireless 3G – IMT 2000, Introduction to LTE-A.

OUTCOMES:
- To able to design systems meeting out the requirements of the recent standards.
- To meet out the industry requirements for man power in next generation networks.
- To be able to contribute towards the enhancement of the existing wireless technologies.

REFERENCES:
OBJECTIONS:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I INTRODUCTION TO WAVELETS
Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTITRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM
Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN
Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES

UNIT V WAVELET APPLICATIONS
Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to apprehend the detailed knowledge about the Wavelet transforms & its applications.

REFERENCES:
5. P.P.Vaidyanathan, _Multi rate systems and filter banks_, Prentice Hall 1993

OBJECTIVES:
- To introduce techniques for altering the existing DSP structures to suit VLSI implementations.
- To introduce efficient design of DSP architectures suitable for VLSI.

UNIT I  PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS  9
Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs – critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II  ALGORITHMIC STRENGTH REDUCTION TECHNIQUE I  9

UNIT III  ALGORITHMIC STRENGTH REDUCTION - II  9

UNIT IV  BIT-LEVEL ARITHMETIC ARCHITECTURES  9
Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon’s bit-serial multipliers using Horner’s rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner’s rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters.

UNIT V  NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING  9

TOTAL: 45 PERIODS

OUTCOME:
- Ability to modify the existing or new DSP architectures suitable for VLSI.

REFERENCES:
OBJECTIVES

- It provides a solid foundation in advanced biomedical signaling and imaging systems including up-to-date coverage of commercially relevant topics.
- It focuses on biomedical signals, processing the signals, and validate the methods and results for optimization of clinical applications.
- To introduce techniques for automated classification and decision making to aid diagnosis.

UNIT I  SIGNAL, SYSTEM AND SPECTRUM  9

UNIT II  TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION  9
Time series analysis – linear prediction models, process order estimation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III  ADAPTIVE FILTERING AND WAVELET DETECTION  9
Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV  BIOSIGNAL CLASSIFICATION AND RECOGNITION  9

UNIT V  TIME FREQUENCY AND MULTIVARIATE ANALYSIS  9
Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students should be able to:
- Carry out multivariate component analysis.
- Explain biosignal classification.

REFERENCES:

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**OBJECTIVES:**
- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of quantum mechanics and nano systems.

**UNIT I**
OVERVIEW

**UNIT II**
MEMS FABRICATION TECHNOLOGIES

**UNIT III**
MICRO SENSORS
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

**UNIT IV**
MICRO ACTUATORS

**UNIT V**
NANOSYSTEMS AND QUANTUM MECHANICS
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

**TOTAL: 45 PERIODS**
OUTCOMES:
At the end of this course, the student should be able to:
- Discuss micro sensors
- Explain micro actuators
- Outline nanosystems and Quantum mechanics

REFERENCES:

AP5291 HARDWARE - SOFTWARE CO-DESIGN

OBJECTIVES:
- To acquire the knowledge about system specification and modelling.
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation.

UNIT I SYSTEM SPECIFICATION AND MODELLING

UNIT II HARDWARE / SOFTWARE PARTITIONING
The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization, HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms.

UNIT III HARDWARE / SOFTWARE CO-SYNTHESIS
The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co-Synthesis Algorithm for Distributed System- Case Studies with any one application

UNIT IV PROTOTYPING AND EMULATION
UNIT V  DESIGN SPECIFICATION AND VERIFICATION  9

TOTAL: 45 PERIODS

OUTCOMES:
• To assess prototyping and emulation techniques
• To compare hardware / software co-synthesis.
• To formulate the design specification and validate its functionality by simulation

REFERENCES:

EL5005  MACHINE VISION  L T P C  3 0 0 3

OBJECTIVES:
• To learn fundamentals of digital image processing
• To understand different types of Image transforms and Models

UNIT I  DIGITAL IMAGE PROCESSING FUNDAMENTALS  9
Elements of visual perception – brightness adaption and discrimination, light and electromagnetic spectrum, Image sensing and acquisition, sampling and quantization, some basic relationships between pixels, connectivity, adjacency, distance measures, different types of image sensors, different types of file formats, fundamental steps in image processing- Examples of the fields that use digital image processing.

UNIT II  IMAGE PROCESSING & RESTORATION  9

UNIT III  IMAGE SEGMENTATION  9
Edge detection, surface orientation ,Thresholding , Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT IV  IMAGE REPRESENTATION  9
UNIT V

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Explain Image smoothening, sharpening and encoding
- Compare Image segmentation methods
- Discuss boundary representation

REFERENCES:

AP5093 ROBOTICS

OBJECTIVES:
- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation

UNIT I  LOCOMOTION AND KINEMATICS

UNIT II  ROBOT PERCEPTION

UNIT III  MOBILE ROBOT LOCALIZATION
UNIT IV  MOBILE ROBOT MAPPING  9

UNIT V  PLANNING AND NAVIGATION  9
Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

OUTCOMES:
Upon Completion of the course, the students will be able to
● Explain robot locomotion
● Apply kinematics models and constraints
● Implement vision algorithms for robotics
● Implement robot localization techniques
● Implement robot mapping techniques
● Implement SLAM algorithms
● Explain planning and navigation in robotics

REFERENCES:

IF5072  CRYPTOGRAPHY AND NETWORK SECURITY  L T P C
3 0 0 3

OBJECTIVES:
The student should be able to
● To understand the mathematics behind Cryptography.
● To understand the standard algorithms used to provide confidentiality, integrity and authenticity.
● To get the knowledge of various security practices applied in the field of information technology

UNIT I  FUNDAMENTALS AND MATHEMATICS OF CRYPTOGRAPHY  9
GF(2^n) Fields.

UNIT II  ENCRYPTION TECHNIQUES

UNIT III  HASH FUNCTIONS AND SIGNATURES

UNIT IV  NETWORK SECURITY

UNIT V  SYSTEM SECURITY

TOTAL : 45 PERIODS

OUTCOMES :
Upon completion of this course, the student will:
- Analyze the basic security algorithms required by any computing system.
- Predict the vulnerabilities across any computing system.
- Design a security solution for any computing system.

REFERENCES :
OBJECTIVES:
- To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
- To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on internetworking requirements, optical backbone and the wireless access part of the network.
- To enable the student to understand the different routing algorithms existing and their performance characteristics.

UNIT I  INTRODUCTION

UNIT II  INTERNET ROUTING
Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III  ROUTING IN OPTICAL WDM NETWORKS
Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting-Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV  MOBILE - IP NETWORKS

UNIT V  MOBILE AD-HOC NETWORKS
Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

OUTCOMES:
Upon Completion of the course, the students will be able to
- Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm, implementing it and analyzing its performance.
- The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.
REFERENCES: