# VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)

## SCHEME OF INSTRUCTION AND EXAMINATION

## B.E. IV/IV – I SEMESTER

| S. No. | Code | Subject | Scheme of Instruction | | | | Scheme Of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Periods/week | | | | Duration in Hrs. | Max. Marks | | |
| | | | L | T | D | P | | Sem. Exam | Sessi-onals | |
| THEORY | | | | | | | | | | |
| 1. | EC 4010 | Microwave Engineering | 3 | 1 | - | - | 3 | 70 | 30 | 3 |
| 2. | EC 4020 | VLSI Design | 3 | 1 | - | - | 3 | 70 | 30 | 3 |
| 3. | EC 4030 | Computer Networks | 3 | 1 | - | - | 3 | 70 | 30 | 3 |
| 4. | EC 4040 | Mobile Cellular Communication | 3 | 1 | - | - | 3 | 70 | 30 | 3 |
| 5. | - | Elective-I | 3 | - | - | - | 3 | 70 | 30 | 3 |
| 6. | ME 4150 | Industrial Administration and Financial Management | 3 | - | - | - | 3 | 70 | 30 | 3 |
| PRACTICALS | | | | | | | | | | |
| 7. | EC 4311 | Microwave Engineering Lab | - | - | - | 3 | 3 | 50 | 25 | 2 |
| 8. | EC 4321 | Electronic Design and Automation Lab | - | - | - | 3 | 3 | 50 | 25 | 2 |
| 9. | EC 4336 | Project Seminar | - | - | - | 2 | - | - | 25 | 1 |
| | | TOTAL | 18 | 4 | - | 8 | - | 520 | 255 | 23 |
| | | GRAND TOTAL | 30 | | | | | 775 | | |

| S.No. | CODE | ELECTIVE – I |
|---|---|---|
| 1 | EC 4050 | Embedded Systems |
| 2 | EC 4060 | Optical Fiber Communication |
| 3 | EC 4070 | Digital Image Processing |
| 4 | EC 4080 | System Automation and Control |
| 5 | EC 4090 | EMI/EMC |
| 6 | EC 4100 | Software for Embedded Systems |
| 7 | EC 4110 | Optimization Techniques |
| 8 | CS 4030 | Information Security |

# MICROWAVE ENGINEERING

| | | |
|---|---|---|
| Subject Code : EC 4010 | Instruction : 3+1 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Students will solve wave equations for guided waves and wave guides<br>• Students will analyze the microwave circuits using S-parameters junctions<br>• Students will understand the principle and operation of microwave sources | **At the end of the course students will be able to:**<br>• Apply the knowledge of wave equations and their solution to analysis of waveguide structures<br>• Analyse circuit properties of passive/active microwave devices.<br>• Interpret the performance characteristics of a microwave circuit<br>• Describe and differentiate common devices such as microwave vacuum tubes and solid state devices<br>• Handle microwave equipment and make microwave measurements. |

**UNIT - I**

Guided Waves: Propagation of TE, TM and TEM waves between parallel planes. Velocity of propagation, wave impedance, attenuation in parallel plane guides.

**UNIT - II**

Waveguides: TE and TM waves in rectangular and circular waveguides, Wave Impedance, Characteristic Wave Impedance, Attenuation and Q of waveguides. Cavity resonators, resonant frequency and Q, Applications of cavity resonator.

**UNIT - III**

Microwave Circuits and Components: Concept of Microwave circuit, Normalized voltage and current, Introduction to scattering parameters and their properties, S parameters for reciprocal and Non-reciprocal components- Magic Tee, Directional coupler, E and H Plane Tees and their properties, Attenuators, Phase Shifters, Isolators and circulators.

**UNIT - IV**

Microwave Tubes: High frequency limitations of conventional tubes, Bunching and velocity modulation, mathematical theory of bunching, principles and operation of two cavity, multi cavity and Reflex Klystron.
Theory of crossed field interaction; Principles and operation of magnetrons and crossed field amplifiers, TWT and BWO.

**UNIT – V**

Microwave Solid State Devices: Principles of operation, characteristics and applications of Varactor, PIN diode, GUNN diode and IMPATT diode.
Elements of strip lines, microstrip lines, slot lines and fin–lines.

**Suggested Reading:**

1. E. C. Jordan & Keith G. Balmain, “Electromagnetic Waves and Radiating Systems”, 2/e, Pearson Education, 2006
2. Samuel Y. Liao, “Microwave Devices and Circuits”, 3/e, Pearson Education, 2003.
3. Rizzi P, “Microwave Devices and Circuits”, 3/e, Pearson Education, 2003.
4. R. E. Collins, “Foundations for Microwave Engineering”, 2/e, John Wiley & Sons, 2012.

# VLSI DESIGN

| | | |
|---|---|---|
| Subject Code : EC 4020 | Instruction : 3+1 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To study the concepts of HDL and to model digital systems.<br>• To understand the MOS fabrication technologies electrical properties and layout development of MOS circuits.<br>• To analyze subsystem design concepts of adders and memories. | **At the end of the course students will be able to:**<br>• Understand the concepts of modeling a digital system using Hardware Description Language<br>• Synthesize a digital system to meet design specifications of the system.<br>• Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies.<br>• Design functional units including adders, shift registers and memories<br>• Draw the stick and layout of basic digital design |

**UNIT - I**

Introduction to HDLs, Basic Concepts of Verilog, Data Types, System Tasks and Compiler Directives.
Gate Level Modeling: Gate Types and Gate Delays. Dataflow Modeling: Continuous assignment and Delays. Design of Stimulus Block.

**UNIT - II**

Behavioural Modeling: Structured Procedures, Procedural Assignments, Timing control, Conditional statements, Sequential and Parallel Blocks, Generate Blocks. Switch level Modeling.
Tasks, Functions, Procedural Continuous Assignments, Design of Mealy and Moore state models using Verilog. Logic Synthesis, Synthesis Design flow, Gate level Netlist.

**UNIT - III**

Introduction to MOS Technology, Basic MOS Transistor action: Enhancement and Depletion Modes. Basic electrical properties of MOS, Threshold voltage and Body Effect. Design of MOS inverters with different loads, Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter.

**UNIT - IV**

MOS and CMOS circuit Design Process: MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams. Basic Circuit Concepts: Sheet Resistance, Area Capacitance and Delay calculation.

**UNIT - V**

Combinational Logic: Manchester, Carry select and Carry Skip adders, Crossbar and barrel shifters, Multiplexer.
Sequential Logic: Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell.
D flip flop using Transmission gates. NOR and NAND based ROM Memory Design.

**Suggested Reading:**


1. Samir Palnitkar, “Verilog HDL: A guide to Digital design and synthesis”, 2/e , Pearson Education, 2008.
2. Michael D. Ciletti, “ Advanced Digital Design with Verilog HDL”, PHI, 2005.
3. Kamran Eshraghian, Douglas A. Pucknell, Sholeh Eshraghian, “Essentials of VLSI circuits and systems”, PHI, 2011.
4. John P. Uyemura, “Introduction to VLSI Circuits and systems”, John Wiley & Sons, 2011.

# COMPUTER NETWORKS

| | | |
|---|---|---|
| Subject Code : EC 4030 | Instruction : 3+1 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To understand the different Topologies and configurations in the area of computer networks.<br>• To understand the terminology and concepts of the OSI model and the TCP/IP model.<br>• To understand the state-of-the-art technology in network protocols, network architecture.<br>• To study contemporary issues and develop new protocols in network security | **At the end of the course students will be able to:**<br>• Analyze principles of LAN design such as topology and configuration depending on types of users accessing the network.<br>• Explore contemporary issues in networking technologies<br>• Identify deficiencies in existing protocols, and then formulate new and better protocols<br>• Analyze and Understand the skills of sub netting and routing<br>• To Apply and use of cryptography and network security in day to day applications. |

**UNIT - I**

Data communication, Network Topologies: LAN, WAN, MAN, Types-Bus, Star, Ring, Hybrid. Line configurations. Reference Models: OSI, TCP/IP.

Data Link Layer: Design issues, Framing, Error Detection and Correction, Flow control Protocols: Stop and Wait, Sliding Window, ARQ Protocols, HDLC.

**UNIT - II**

MAC Sub Layer: Multiple Access Protocols: ALOHA, CSMA, Wireless LAN. IEEE 802.2, 802.3, 802.11, 802.16 standards. Bluetooth, Bridges and Routers.

Circuit switching: Circuit Switching Principles and concepts.

Packet switching: Virtual circuit and Datagram subnets.

**UNIT - III**

Network Layer: Network layer Services, Routing algorithms : Shortest Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast, Distance Vector Routing, and Congestion Control Algorithms.

Internet Working: The Network Layer in Internet and ATM Networks.

**UNIT - IV**

Transport Layer: Transport Services, Elements of Transport Layer, Connection management, TCP and UDP protocols, ATM AAL Layer Protocol.

**UNIT - V**

Application Layer: Domain Name System, SNMP, Electronic Mail, World Wide Web.

Network Security: Cryptography Symmetric Key and Public Key algorithms, Digital Signatures, Authentication Protocols.

**Suggested Reading:**

1. Andrew S Tanenbaum “ Computer Networks” 5/ed. Pearson Education, 2011.
2. Behrouz A. Forouzan “ Data Communication and Networking” 3/e, TMH, 2008.
3. William Stallings “Data and Computer Communications”, 8/e, PHI, 2004.
4. S.Keshav “An Engineering Approach to Computer Networks” 2/e, Pearson Education.

# MOBILE CELLULAR COMMUNICATION

| | | |
|---|---|---|
| Subject Code : EC 4040 | Instruction : 3+1 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To provide fundamental principles and concepts required to understand the cellular communication systems and standards.<br>• To apply analytical techniques for characterization of wireless channel.<br>• To provide problem solving skills required to analyse and evaluate the performance of cellular communication systems. | **At the end of the course students will be able to:**<br>• Demonstrate the fundamental knowledge of mobile cellular communication.<br>• Apply the knowledge acquired to formulate and solve problems related to mobile cellular communication.<br>• Analyze different radio channel models, cellular communication system architectures, standards and evaluate the performance of the system.<br>• Carryout simulation using modern tools to understand the impact of different performance parameters.<br>• Become acquainted with recent advancements and developments in the area of mobile cellular communication. |

**UNIT - I**
Basic Cellular system and its operation, frequency reuse, channel assignment strategies, Handoff process, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Cross talk, Enhancing capacity and cell coverage, Trunked radio system.

**UNIT - II**
Free space propagation model, three basic propagation mechanisms, practical link budget design using path loss models, outdoor propagation models: Durkin's model and indoor propagation model, partition losses. Small scale multipath propagation, Parameters of mobile multipath channels, types of small scale fading.

**UNIT - III**
FDMA, TDMA, SSMA, FHMA, CDMA, SDMA, Packet radio protocols, CSMA, Reservation protocols.

**UNIT - IV**
GSM: Services and Features, System architecture, Radio Sub system, Channel Types, Frame structure and Signal processing.
CDMA: Digital Cellular standard IS-95, Forward Channel, Reverse Channel.

**UNIT - V**
Comparison of 1G, 2G and 2.5G, technology Features of 3G and 4G, WLAN, Bluetooth, PAN, Trends in Radio and Personal Communications, UMTS system architecture and Radio Interface, introduction to CDMA 2000.

**Suggested Reading :**

1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice”, 2/e, Pearson Education, 2010
2. William. C.Y.Lee, “Mobile Communication Engineering”, 2/e , Mc-Graw Hill, 2011.
3. T.L.Singal “Wireless Communication Systems”, 1/e, TMH Publications, 2010.
4. William.C.Y.Lee, “Mobile Cellular Telecommunications: Analog and Digital Systems”, 2/e, Mc-Graw Hill, 2011.

# INDUSTRIAL ADMINISTRATION & FINANCIAL MANAGEMENT

| Subject Code : ME 4150 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
|---|---|---|
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course are to:**<br>• aware about types of business forms, organization structures, plant layouts, merits, demerits and applications.<br>• understand method study procedure, PME, time study techniques and wage incentives.<br>• importance of PPC and improving quality by control charts and sampling plants.<br>• optimization of inventory to minimize total cost and other optimization techniques like LPP, project management techniques.<br>• estimate selling price of a product, TVM and budgeting techniques, depreciation methods. | ***On completion of the course, the student will be able to:***<br>• understand business forms, organization structures and plant layouts.<br>• implementation of method study and estimation of standard time.<br>• understand types of production, functions of PPC, quality control by charts and sampling.<br>• implement optimization techniques like LPP, assignment and project management techniques.<br>• understand BEA, estimation of depreciation, selling price of a product and capital budgeting techniques. |

**UNIT – I**

Industrial Organization : Types of various business organisations. Organisation structures and their relative merits and demerits. Functions of management.

Plant location and layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.

**UNIT – II**

Work study: Definitions, Objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time– by– time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.

**UNIT – III**

Inspection and quality control: Types and objectives of inspection S.Q.C., its principles quality control by chart and sampling plans. Quality circles, introduction to ISO.

Production planning and control: Types of manufacture. Types of production. Principles of PPC and its function. Production control charts.

**UNIT – IV**

Optimisation: Introduction to linear programming and graphical solutions. Assignment problems.

Project Management: Introduction to CPM and PERT. Determination of critical path.

Material Management: Classification of materials. Materials planning. Duties of purchase manager. Determination of economic order quantities. Types of materials purchase.

**UNIT – V**

Cost accounting: elements of cost. Various costs. Types of overheads. Break even analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money. Techniques of capital budgeting and methods. Cost of capital. financial leverage.

**Learning Resources:**


1. Pandey I.M., “Elements of Financial Management”, Vikas Publ. House, New Delhi, 1994
2. Khanna O.P., “Industrial Engineering and Management”, Dhanapat Rai & Sons.
3. Everrete E Admaa & Ronald J Ebert , “production and Operations Management”, 5$^{th}$ Ed. , PHI , 2005
4. S N Chary, “Production and Operations Management”, 3$^{rd}$ Ed. , Tata McGraw Hill, , 2006
5. Pannerselvam, “production and Operations Management”, Pearson Education, 2007

# MICROWAVE ENGINEERING LAB

| | | |
|---|---|---|
| Subject Code : EC 4311 | Instruction : 3 Periods per week | Sessionals Marks : 25 |
| SEM Exam Marks : 50 | SEM Exam Duration : 3 Hours | Credits: 02 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Will estimate guide wavelength and free space wave length<br>• Will characterize the MW junctions using s-parameters<br>• Will study the characteristics of microwave sources. | **At the end of the course students will be able to:**<br>• Identify microwave sources for diversified applications<br>• Estimate the guide wave length and free space wave length of a wave.<br>• Analyze the Microwave transmission lines and unknown load using VSWR.<br>• Formulate the scattering matrix of microwave junctions.<br>• Analyze the characteristics of microwave devices. |

## List of Experiments

1. Characteristics of Reflex Klystron oscillator, finding the mode numbers and efficiencies of different modes.
2. Characteristics of Gunn diode oscillator, Power Output Vs Frequency, Power Output Vs Bias Voltage.
3. Measurement of frequency and Guide wavelength calculation:
   i. Verification of the relation between Guide wavelength, free space wavelength and cutoff wavelength of X- band rectangular waveguide.
   ii. Verification of the straight line relation between $(1/\lambda_g)^2$ and $(1/\lambda_0)^2$ and finding the dimension of the guide.
4. Measurement of low and high VSWRs: VSWR of different components like matched terminals, capacitive and inductive windows, slide screw tuner for different heights of the tuning posts etc.
5. Measurement of impedance.

To find the parameters and scattering matrices of different microwave components like:

6. Directional coupler.
7. Tees: E plane, H plane and Magic Tee.
8. Circulator.
9. Measurement of radiation patterns for basic microwave antennas like horn and parabolic reflectors in E-plane and H-plane. Also to finding the gain, bandwidth and beamwidth these antennas.
10. Study of various antennas like dipoles, loops, Yagi antenna, log periodic antenna and their radiation pattern.
11. Mini Project:
    i. To design microwave components such as: Directional couplers, circulators and Hybrid junctions using simulation software tools.
    ii. To design antenna arrays such as: Binomial, Chebyshev, using software tools.

# ELECTRONIC DESIGN AND AUTOMATION LAB

| | | |
|---|---|---|
| Subject Code : EC 4321 | Instruction : 3 Periods per week | Sessionals Marks : 25 |
| SEM Exam Marks : 50 | SEM Exam Duration : 3 Hours | Credits: 02 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To simulate and synthesize combinational & sequential logic circuits using EDA tools.<br>• To learn implement procedure for any Digital design on FPGA | **At the end of the course students will be able to:**<br>• Familiarize the use of modern EDA tools to design digital logic circuits and system.<br>• Apply the knowledge to develop Verilog HDL for digital circuits in various level of abstraction.<br>• Develop stimulus block / Test bench in Verilog HDL to verify the functionality of design block.<br>• Prototype digital hardware circuits using FPGA for real time application. |

**Part A**

Write the Code using VERILOG, Simulate and synthesize the following

1. Arithmetic Units: Adders and Subtractors.
2. Multiplexers and Demultiplexers.
3. Encoders, Decoders, Priority Encoder and Comparator.
4. 8-bit parallel adder using 4-bit tasks and functions.
5. Arithmetic and Logic Unit with minimum of eight instructions.
6. Flip-Flops.
7. Registers/Counters.
8. Sequence Detector using Mealy and Moore type state machines.

Note:-

1. All the codes should be implemented appropriately using Gate level, Dataflow and Behavioral Modeling.
2. All the programs should be simulated using test benches.
3. Minimum of two experiments to be implemented on FPGA/CPLD boards.

**Part B**

Transistor Level implementation of CMOS circuits

1. Basic Logic Gates: Inverter, NAND and NOR.
2. Half Adder and Full Adder.
3. 4:1 Multiplexer.
4. 2:4 Decoder.

**Mini project:**

i) 8 bit CPU
ii) Generation of different waveforms using DAC
iii) RTL code for Booth's algorithm for signed binary number multiplication
iv) Development of HDL code for MAC unit and realization of FIR Filter
v) Design of 4-bit thermometer to Binary Code Converter

# PROJECT SEMINAR

| | | |
|---|---|---|
| Subject Code : EC 4336 | Instruction : 2 Periods per week | Sessionals Marks : 25 |
| SEM Exam Marks : - | SEM Exam Duration : - | Credits: 01 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>Prepare the student for a systematic and independent study of the state of the art topics in a broad area of his / her specialization. | **At the end of the course students will be able to:**<br>• Selection of a suitable topic / problem for investigation and presentation.<br>• Carryout literature survey and prepare the presentation.<br>• Formulating the problem, identify tools and techniques for solving the problems.<br>• Clear communication and presentation of the seminar topic.<br>• Apply ethical principles in preparation of project seminar report. |

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in a broad area of his / her specialization.

Project seminar topics may be chosen by the student with advice and approval from the faculty members.
Students are to be exposed to the following aspects of seminar presentation.

- Literature Survey
- Organization of the material
- Presentation of OHP slides / PC presentation
- Technical writing

*Each student is required to:*

1. Submit a one-page synopsis before the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC, Slide project followed by a 10 minutes discussion.
3. Submit a report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week of the semester to the last week of the semester and any change in schedule should be discouraged..

For award of sessional marks students are to be judged by the last two faculty members on the basis of an oral and written presentation as well as their involvement in the discussions.

# EMBEDDED SYSTEMS
## (Elective - I)

| | | |
|---|---|---|
| Subject Code : EC 4050 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Define and classify embedded system and to interpret design process and challenges.<br>• Summarize the RISC concepts and describe the ARM architecture, Interpret serial and parallel bus communication protocols<br>• Describe system design and co-design issues along with various laboratory, IDE tools and case studies in embedded system design. | **At the end of the course students will be able to:**<br>• Define embedded system and describe the embedded system product design life cycle and challenges.<br>• Analyze the ARM Core embedded design and its programming model.<br>• Apply knowledge to design networked embedded systems using serial, parallel and wireless communication protocols.<br>• Justify the importance of hardware software co-design and models involved.<br>• Acquire the knowledge of embedded IDEs to design & specify debugging techniques. |

**UNIT – I**
Embedded System Design: Introduction, Trends, Definition, Classifications; Embedded Product Development Life Cycle. CPU selection–hardware, software and I/O. Challenges in designing Embedded System; Design Metric of Embedded System.

**UNIT – II**
ARM Processor Fundamentals–Nomenclature; Core Architecture; AMBA Bus–ASB, APB; Registers; core operating modes; Pipeline; Introduction to Thumb Mode; Exceptions, OBD using JTAG; ARM Revisions, ARM families–Cortex Cores; Comparisons; Case Study with LPC2148

**UNIT – III**
Embedded Networking: UART, $I^2C$, IrDa, CAN, IEEE1394 and USB.
PCI for embedded systems.
TCP/IP: Issues of porting; Socket selection; HTTP client-server model Issues in porting Wireless Stacks–choices and challenges.

**UNIT – IV**
Hardware Software Co–design: Motivation, Definition
Co-Design for System Specification and modeling: Single-processor and Multi-Processor Architectures, comparison of Co-Design Approaches; Formulation of the HW/SW scheduling, Optimization

**UNIT – V**
Embedded software development tools: Host and Target machines, native tools – IDEs; cross-compilers, GCC
Embedded Software Architectures–Round Robin, RR with Interrupt driven, Functional Queue and introduction to RTOS.
Debugging Methods: Testing on Host–Instruction set Simulators, ICE, JTAG, laboratory tools: Multi meter, CRO, Logic Analyzer and protocol sniffers.

**Suggested Readings:**
1. Frank Vahid, Tony Givargis "Embedded System Design – A Unified Hardware/Software Introduction" John Wiley & Sons, Inc. 2002.
2. Andrew N Sloss, Dominic Symes & Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", The Morgan Kaufmann Series 2004.
3. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006.
4. David E Simon, "An Embedded Software Primer", Pearson Education, 2005

# OPTICAL FIBER COMMUNICATION
## (Elective-I)

| | | |
|---|---|---|
| Subject Code : EC 4060 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Understand optical fiber configuration and modes.<br>• Estimate losses in optical waveguides<br>• Study the characteristics of different light sources and detectors<br>• Analyze the effects of temperatures, bending noise on fiber optic system performance.<br>• Estimate the link power budget | **At the end of the course students will be able to:**<br>• Apply the knowledge of basic mathematics and science to identify the different types and modes of fiber optic cable.<br>• Analysis the different losses in fiber optic cable.<br>• Choose the different materials, sources, amplifiers and joints for optical communication.<br>• Interpret the different detectors, receiver data for used in receivers and networks<br>• Estimation of link power budget, noise to analyse the system performance. |

**UNIT - I**

Evolution of fiber optic system, Elements of Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Waveguides, Overview of Modes and Key concepts, Linearly Polarized Modes, Single Mode Fibers and Graded Index fiber structure.

**UNIT - II**

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination, Group Delay, Material Dispersion, Waveguide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in Guided Index fibers, Mode Coupling, Design Optimization of Single Mode fibers-Refractive Index profile and cut-off wavelength.

**UNIT - III**

Direct and indirect Band gap materials, LED structures, Light source materials, Quantum efficiency, LED power, Modulation of LED, laser Diodes, Modes and Threshold condition, Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Lensing schemes, Fiber-to-Fiber joints, Fiber splicing.

**UNIT - IV**

PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit.

**UNIT - V**

Point-to-Point link system considerations -Link Power budget, Rise - time budget, Noise Effects on System Performance, Operational Principles of WDM, Solitons, Erbium-doped Amplifiers. Introductory concepts of SONET/SDH Network.

**Suggested Readings:**

1. Gourd Keiser, "Optical Fiber Communication" TMH, 4/e, 2000.
2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 1994.
3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
4. Binh, “Digital Optical Communications”, First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications

# DIGITAL IMAGE PROCESSING
## (Elective-I)

| Subject Code : EC 4070 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
|---|---|---|
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To understand the elements of digital image processing and note its importance in various applications.<br>• To acquire the knowledge on image transforms to be implemented for image enhancement, image restoration and image compression.<br>• To study various coding techniques being used. | **At the end of the course students will be able to:**<br>• Apply knowledge of mathematics on images, for image enhancement and for noise removal.<br>• Identify appropriate techniques for image compression and image restoration<br>• Use of various image transformation techniques needed in image processing.<br>• Analyze and implement image processing algorithms.<br>• Acquire knowledge of various restoration techniques. |

**UNIT - I**

Elements of Digital Image Processing Systems, Digital image representation, elements of visual perception, Image sampling and Quantization, Basic Relationships between pixels.

**UNIT - II**

Fourier transform, FFT, Discrete cosine transform, Hadamard transform, Haar transform, Slant transform and Hotelling transform and their properties.

**UNIT - III**

Spatial enhancement techniques: Histogram equalization, direct histogram specification, Local enhancement.

Frequency domain techniques: Low pass, High pass and Homomorphic Filtering, Image Zooming Techniques.

**UNIT - IV**

Image Degradation model, Algebraic approach to restoration, inverse filtering, Least mean square filter, Constrained least square restoration and interactive restoration. Speckle noise and its removal techniques.

**UNIT - V**

Redundancies for image compression, Huffman Coding, Arithmetic coding, Bit-plane coding, loss less and lossy predictive coding. Transform coding techniques: Zonal coding and Threshold coding.

**Suggested Reading:**

1. Gonzalez R.C. and Woods R.E. Digital Image Processing, 2nd edition, PHI, 2005.
2. Jain Anil K, Fundamentals of Digital Image Processing, PHI, 1989.
3. Madhuri A.Joshi,”Digital Image Processing: An algorithmic approach',PHI,2006.
4. Qidwai, “Digital Image Processing”, First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications

# SYSTEM AUTOMATION AND CONTROL
## (Elective-I)

| | | |
|---|---|---|
| Subject Code : EC 4080 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Students are exposed to the various operations involved in making a system (gadget) to deliver the expected output.<br>• They realize that the central tasks of an automated system is stimulus measurement and controlling the output.<br>• The way the output is controlled is by comparing the final output with the expected output and provide the required correction by adjusting the input or some intermediate process parameters<br>• The student should realize that this correcting mechanism (feedback) introduces problems of stability which should be addressed in automated systems | **At the end of the course students will be able to:**<br>• Address the problem of automation of a systems in daily life<br>• To appreciate the need for automation in systems in their area of work |

**UNIT - I**

Introduction to sensors and transducers: displacement, position, and proximity, velocity and motion, force, fluid pressure, liquid flow, liquid level, temperature, light. Selection of sensor.

**UNIT - II**

Data acquisition and Signal conditioning: various signal conditioning modules. Use of data acquisition. Fundamentals of Analog to digital conversion, sampling, amplifying, filtering, noise reduction. Criteria to choose suitable data acquisition equipment.

**UNIT - III**

Introduction to systems: Measurement and control. Basic system models. Mathematical models. Mechanical system building blocks, Electrical system building blocks, Fluid system building blocks and Thermal system building blocks. Engineering systems: Rotational – translational, Electromechanical, hydraulic-mechanical.

**UNIT - IV**

Dynamic responses of systems, system transfer functions, frequency response, closed loop controllers. Microcontroller basics, architecture, hardware interfacing, programming a microcontroller. Programmable logic controllers: basic structure, input/output processing, programming, selection of a PLC.

**UNIT - V**

Motion control and robotics: concepts of motion control system and real world applications. Components of a motion control system. Motion controller, Motors and mechanical elements, move types, Motor amplifiers and drives. Feed back devices and motion input/output.

**Suggested Reading**:


1. W. Bolton, “Mechatronics: Electronic control systems in mechanical and electrical Engineering”, 3/e, Pearson Education, 2008.
2. Robert A. Witte, “Electronic Test Instruments: Analog and Digital Measurements”, 2/e, Pearson Education, 2002.
3. Dan Necsulescu, “Mechatronics”, 1/e, Pearson Education, 2002.
4. De Silva, “ Mechatronics”, First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications.

# EMI and EMC
## (Elective - I)

| Subject Code : EC 4090 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
|---|---|---|
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Study the sources, predication and modeling of EMI<br>• Understand transmitter models for EMI prediction<br>• Model antennas for amplitude culling and frequency culling for EMI prediction<br>• Study open area test, EMI test site measurement and precautions<br>• Analyze EMI filter characteristics. | **At the end of the course students will be able to:**<br>• Model EMI sources<br>• Predict detailed performance of various emissions<br>• Model antennas for EMI predictions<br>• Perform EMI measurement<br>• Analyse and choose EMI filter characteristics. |

**UNIT – I**

Sources of EMI – Intersystems and Intrasystem, EMI predictions and modeling, Cross talk, Cable wiring and coupling, Shielding and Shielding materials, Grounding and bouding.

**UNIT – II**

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

**UNIT – III**

Antenna models for EMI prediction:
Antenna EMI prediction considerations, Antenna models for amplitude culling, Frequency culling and detail prediction. Propagation models for EMI prediction:
Propagation considerations, Propagation models for amplitude culling, Propagation models and details predictions.

**UNIT – IV**

EMI measurements – Open area test site measurements, Measurement precautions, Radiated and conducted interference measurements, Control requirements and test methods.

**UNIT – V**

EMI filters characteristics of LPF, HPF, BPF, BEF, EMI standards – Military and Industrial standards, FCC regulations.

**Suggested Reading:**

1. William Duff G., & Donald White R. J, *Series on Electromagnetic Interference and Compatibility*, Vol. 5, EMI Prediction and Analysis Technique – 1972.
2. Dr. Prasad Kodali V., *Engineering Electromagnetic Compatibility*, S. Chand, 1996.
3. Weston David A., *Electromagnetic Compatibility, Principles and Applications,* 1991.
4. Kaiser B. E., *Principles of Electromagnetic Compatibility* – Artech House, 1987.

# SOFTWARE FOR EMBEDDED SYSTEMS
## (Elective – I)

| | | |
|---|---|---|
| Subject Code : EC 4100 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Differentiate C Vs Embedded C and demonstrate C++ for designing embedded application software<br>• Apply embedded Linux principles and list the compiler tools essential for embedded Linux<br>• Design software using Real-Time OS and summarize Python language principles. | **At the end of the course students will be able to:**<br>• Summarize and differentiate the importance of C & C++ for embedded system development.<br>• List GCC compiler tool chain in Linux for Embedded Systems<br>• Demonstrate object oriented programming using C and apply embedded C principles in designing software for embedded systems<br>• Differentiate embedded OS with traditional OS along with scheduling and kernel principles.<br>• Narrate the Python language constructs along with syntax and apply in embedded software |

**UNIT - I:** EMBEDDED PROGRAMMING
C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

**UNIT - II:** C PROGRAMMING TOOLCHAIN IN LINUX
C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof – Memory Leak Detection with valgrind - Introduction to GNU C Library

**UNIT - III:** EMBEDDED C
Adding Structure to ‘C’ Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

**UNIT - IV:** EMBEDDED OS
Creating embedded operating system: Basis of a simple embedded OS, Introduction to μC/OS-II, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using μC/OS-II - Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

**UNIT - V:** Embedded C++
Object Orented Programming; Approach; Comparisions; Features
Reusable Objects; Templates Usage
Exception Hanlding; Case Study

**Suggested Reading:**

1. Steve Oualline, ‘Practical C Programming 3rd Edition’, O’Reilly Media, Inc, 2006.
2. Stephen Kochan, “Programming in C”, 3rd Edition, Sams Publishing, 2009.
3. Michael J Pont, “Embedded C”, Pearson Education, 2007.

# OPTIMIZATION TECHNIQUES
## (Elective – I)

| | | |
|---|---|---|
| Subject Code : EC 4110 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To introduce the fundamental concepts of Optimization Techniques;<br>• to make the learners aware of the importance of optimizations in real scenarios;<br>• To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable. | **At the end of the course students will be able to:**<br>• Formulate optimization problems;<br>• Understand and apply the concept of optimality criteria for various type of optimization problems;<br>• Solve various constrained and unconstrained problems in single variable as well as multivariable;<br>• Apply the methods of optimization in real life situation. |

**Unit – I**

Introduction of Optimization: Historical development – Classical Optimization techniques, Single variable multivariable optimization. Solution by Lagrange multiplier method. Kuh'n and Tucker conditions. Multivariable optimization problem with and without constraints.

**Unit – II**

Linear Programming: Standard form, solution of simultaneous equations by pivotal condensation, Simplex algorithm, Duality principle, revised simplex method.

**Unit – III**

Non-Linear Programming: One dimensional search methods. Fibonacci method, golden section method. Interpolation methods.

**Unit – IV**

Unconstrained Optimization: Direct search method, Univariate search and pattern search methods. Powell's Method.

**Unit – V**

Gradient methods: Steepest Descent, Conjugate gradient and quasi Newton method. Fletcher – Reeves method of conjugate gradients.

**Suggested Reading:**

1. Rao S.S., *Optimization Theory and Application*, Wiley Eastern, 2004.
2. Jasbir S. Arora, *Introduction to Optimum Design*, PHI, 1989.
3. Hillier & Hiebarman, *Introduction to Operations Research*, TMH, New Delhi, 2004.

# INFORMATION SECURITY
## (Elective – I)

| | | |
|---|---|---|
| Subject Code : CS 4030 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Summarize the importance of Security System Development Life Cycle<br>• Classify various attacks and suggests various Risk Management Techniques<br>• Develop blueprint for security and analyse various Cryptographic algorithms being adopted in Information Security. | **At the end of the course students will be able to:**<br>• Classify various threats and attacks and list the components involved in the ISS.<br>• Summarize components involved in ethical hacking & associated risks.<br>• Design blueprint for providing security with Firewalls and analysis tools.<br>• Demonstrate different cryptographic algorithms in place for ISS<br>• Lists SSL & SET protocols required for designing secured e-Transactions. |

**UNIT – I**
Introduction, Characteristics of Information, Components of Information Systems, Securing components, balancing Security and Access.
The Security System Development Life Cycle, Security Professionals and the organization.
Security Investigation Phase, Need for security, Threats, Attacks.

**UNIT – II**
Legal, Ethical and Professionals Issues Introduction, Information Security. Ethical Component in System, Codes of Ethics, Certification. Security Analysis: Risk Management, Identifying and assessing risk, Controlling Risk.

**UNIT – III**
Logical Design: Blue print for security. Security Policy, standards and Practices. Design of Security Architecture. Physical Design: Security Technology, Physical Design of Security SDLC Firewalls, Dialup Protection, Intrusion Detection Systems, Scanning and analysis tools, Content filters.

**UNIT – IV**
Cryptography: The basis elements of cryptography, symmetric (Symmetric Key-DES, IDEA, and AES) and public key cryptography (Public key Encryptions-RSA).

**UNIT – V**
Message digest (MD-5, SHA),, Digital signatures. SSL and SET: SSL and SET protocols, Internet transactions using both SSL and SET.

**Suggested Reading:**

1. Michael E. Whitman and Herbert J Mattord, Principles of Information Security, 2nd Ed. Cengage Learning 2008.
2. William Stallings, Cryptography and Network Security, Pearson Education, 2000.
3. Nina Godbole, Information Systems Security, Wiley-2009

# DEPARTMENT OF
# ELECTRONICS & COMMUNICATION ENGINEERING

**Scheme of Instruction**
**and**
**Syllabi of**

## B.E. (ECE)

## IV/IV - II Semester

**(With effect from 2017-2018)**

**VASAVI COLLEGE OF ENGINEERING**
**(Autonomous Institution Under UGC)**
**Ibrahimbagh, Hyderabad - 500 031.**
Telangana.

# VASAVI COLLEGE OF ENGINEERING

## SCHEME OF INSTRUCTION AND EXAMINATION

## B.E. IV/IV – II SEMESTER

| S. No. | Code | Subject | Scheme of Instruction | | | | Scheme of Examination | | | credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Periods/week | | | | Duration in Hours | Max. Marks | | |
| | | | L | T | D | P | | Ext. Exam | Sessio-nal | |
| **THEORY** | | | | | | | | | | |
| 1. | --- | Elective - II | 3 | - | - | - | 3 | 70 | 30 | 3 |
| 2. | --- | Elective - III | 3 | - | - | - | 3 | 70 | 30 | 3 |
| **PRACTICALS** | | | | | | | | | | |
| 3. | EC 4425 | Project / Internship | - | - | - | 18 | Viva-Voce | 50 | 50 | 9 |
| | | **TOTAL** | **6** | **-** | **-** | **18** | **-** | **190** | **110** | **15** |
| | | **GRAND TOTAL** | **24** | | | | | **300** | | |

| S.No. | CODE | ELECTIVE – II |
|---|---|---|
| 1 | EC 4170 | Real Time Operating Systems |
| 2 | EC 4180 | Coding Theory and Techniques |
| 3 | EC 4190 | Design of Fault Tolerant Systems |
| 4 | EC 4200 | Speech Processing |
| 5 | EC 4210 | Wireless Sensor Networks |
| 6 | EC 4220 | Power Electronics |
| 7 | EC 4230 | Biomedical Signal Processing |
| 8 | EC 4240 | Radar and Navigational Systems |

| S.No. | CODE | ELECTIVE – III |
|---|---|---|
| 1 | EC 4250 | Nano Technology |
| 2 | EC 4260 | Global Positioning Systems |
| 3 | EC 4270 | Neural Networks and Fuzzy Logic |
| 4 | EC 4280 | Spectral Estimation Techniques |
| 5 | EC 4290 | Multi Rate Signal Processing |
| 6 | EC 4300 | Telemetry and Telecontrol |
| 7 | EC 4310 | Graph Theory in Engineering Applications |
| 8 | EC 4320 | Satellite Communication Systems |

## PROJECT / INTERNSHIP

| | | |
|---|---|---|
| Subject Code : EC 4425 | Instruction : 18 Periods per week | Sessionals Marks : 50 |
| SEM Exam Marks : 50 | SEM Exam Duration : Viva-voce | Credits: 09 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• The objective of the project work is to make use of the knowledge gained by the student at various stages of the degree course.<br>• Students, will also be permitted to undertake industrial/consultancy project Work, outside the department, in industries/Research labs. | **At the end of the course students will be able to:**<br>• Demonstrate capacity to identify an advanced topic for project work in core and allied areas.<br>• Gather information related to the topic through literature survey.<br>• Comprehend gathered information through critical analysis and synthesis.<br>• Solve engineering problems pertinent to the chosen topic for feasible solutions. CO5. Use the techniques, skills and modern engineering tools necessary for project work.<br>• Do time and cost analysis on the project.<br>• Plan, prepare and present effective written and oral technical report on the topic. CO8. Adapt to independent and reflective learning for sustainable professional growth. |

**Dealing with a real time problem should be the focus of under graduate project.**

Faculty members should prepare project briefs (giving scope and references) well in advance, which should be made available to the students in the department.
The project may be classified as hardware / software modeling / simulation. It may comprise any or all elements such as analysis, design and synthesis.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students ( a maximum of 3 in group )
- Allotment of projects and project guides
- Project monitoring at regular intervals.

All project allotment are to be completed by the 4$^{th}$ week of IV–Year, I-Semester, so that the students get sufficient time for completion of the project.

All projects will be monitored at least twice in a semester through individual presentations.

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the grades / marks, awarded by a monitoring project committee of faculty members as well as the marks given by the guide.

Efforts be made the some of the projects are carried out in reputed industries / research organizations with the help of industry coordinators. Problems can also be invited from the industries to be worked out through undergraduate projects.

Common norms should be established for final documentation of the project report by the respective department on the following lines:

1. The project little should be task oriented for example "Analysis and Modeling of ……….."
2. Objectives of the project should be identified clearly and each student of the project batch should fulfill at least one of the objectives identified. The chapters of the project report should reflect the objectives achieved.

3. Contents of the report should include the following
    a. Title page
    b. Certificate
    c. Acknowledgements
    d. Abstract (limited to one/two paragraphs, page no.1 should start from this)
    e. Contents (Ch. No. Title of the chapter/section Page No.)
    f. List figures (Fig. No. caption of the figure Page No.)
    g. List of Tables (Table. No. Caption of the table Page No.)
    h. List of Symbols (ex. C: Velocity of light 3 × 108 m/s )
    i. Chapter I should be introduction (limited 4-5 Pages) This should contain sections as objectives of the project, technical approach, literature survey, the importance of the project and organization of the report.
    j. Chapter II, Last two chapters should be on results with discussions and conclusions.
    k. References in IEEE format which should be duly referred in the report.
    l. Appendices
       The algorithm related to the software developed should be thoroughly discussed.
    m. Index.

4. The project reports should be hard bound.

The project work if found inadequate and gets an Unsatisfactory grade, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

The project report should be evaluated and one of the following grades may be awarded at the external examination.

@: Excellent / Very Good / Good / Satisfactory / Unsatisfactory.

# REAL TIME OPERATING SYSTEMS (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4170 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Define kernel, categorize kernels and differentiate RTOS scheduling principles.<br>• Demonstrate various Inter Process Communication techniques used in RTOS.<br>• Describe Memory and I/O management policies with comparison of Proprietary and royalty free kernels. | **At the end of the course students will be able to:**<br>• Define kernel and classify different kernels and justify the need of multitasking.<br>• Differentiate Round robin, EDF and RMS preemptive scheduling policies.<br>• Summarize Inter Process Communication resources available in RTOS.<br>• Analyze different Memory and I/O management policies used in RTOS<br>• Compare commercial and royalty-free RTOS. |

**UNIT – I**
**Introduction to OS and RTOS :** Architecture of OS (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed & real –time O.S.

**UNIT – II**
**Process Management of OS/RTOS :** Uniprocessor Scheduling: Types of scheduling, *scheduling algorithms:* FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept, Real Time Scheduling concepts.

**UNIT –III**
**Process Synchronization : Concurrency :** Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing, Monitors, Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem. **Deadlock:** Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies.

**UNIT – IV**
**Memory & I/O Management :** Memory Management requirements, *Memory partitioning:* Fixed, dynamic, partitioning, Buddy System Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging, Page Replacement Policies (FIFO, LRU, Optimal, clock) ,Thrashing, Working Set Model.
*I/O Management and Disk Scheduling:* I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches.

**UNIT – V**
**RTOS APPLICATION DOMAINS :** Comparison and study of RTOS: Vxworks and µCOS – *Case studies:* RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.

**Suggested Reading:**

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design," 2/e, Kindle Publishers, 2005.
2. Tanenbaum,"Modern Operating Systems," 3/e, Pearson Edition, 2007.
3. Jean J Labrosse,"Embedded Systems Building Blocks Complete and Ready-to-use Modules in C,"2/e, 1999.
4. C.M.Krishna and G.Shin, "Real Time Systems," McGraw-Hill International Edition, 1997.

# CODING THEORY AND TECHNIQUES
# (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4180 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To understand the process of digital transmission<br>• To study different error control techniques in digital transmission<br>• To apply encoding and decoding techniques | **At the end of the course students will be able to:**<br>• Apply the probabilistic method to construct different types of source codes.<br>• Identify different types of errors and to comprehend various error control code properties.<br>• Apply linear block codes and convolution codes for error detection and correction.<br>• Generate LDPC codes using Gallager's method of construction and to demonstrate the BER performance of LDPC codes.<br>• Construct Galois Fields and to apply them to generate BCH and RS codes for Channel performance improvement against burst errors. |

**UNIT - I**

**Introduction :** Coding for Reliable Digital Transmission and Storage, Types of codes, Modulation and Coding, Maximum Likelyhood Decoding, Types of errors, Source coding: Shannon-Fano coding, Huffman codes, Run-Length Encoding, Lampel-Ziv codes.

**UNIT - II**

**Block codes :** Important Linear Block Codes, Repetition codes, Hamming codes, a class of single error-correcting and double-error correcting codes, Reed-Muller codes, the (24,12) Golay code, Product codes, Interleaved codes.

**UNIT - III**

**Convolutional codes :** Encoding, Structural properties, State diagram, Code tree diagram, Maximum-Likelihood decoding, Soft decision and hard decision decoding, the Viterbi algorithm.

**UNIT - IV**

**Low Density Parity Check codes:** Introduction, Galleger's method of construction, Regular and Irregular LDPC codes, other methods of constructing LDPC codes, Tanner graphs, Decoding of LDPC codes.

**UNIT - V**

**BCH and RS codes :** Groups, Fields, Binary arithmetic, Construction of Galois Fields GF($2^m$), Basic properties of Galois Fields, Introduction to BCH and RS codes.

**Suggested Reading:**

1. Shu Lin and Daniel J. Costello, Jr. "*Error Control Coding,*" 2/e, Pearson, 2011.
2. K Sam Shanmugum, "*Digital and Analod Communication Systems,*" Wiley, 2010.
3. Simon Haykin, "*Digital Communication,*" TMH, 2009.

# DESIGN OF FAULT TOLERANT SYSTEMS
# (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4190 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Understand the concepts of reliability, failures and reliability testing.<br>• Learn various concepts related to fault tolerant design, redundancy and error correction.<br>• Study the concept of self checking circuits.<br>• Study the concepts of testable designs, controllability and observability and built in self test (BIST). | **At the end of the course students will be able to:**<br>• Apply test techniques such as iddq test, at speed test and delay test for system testing<br>• Use the appropriate test algorithm methods for achieving fault coverage specification in design<br>• Apply fault tolerant methods to increase the reliability for system design<br>• Describe accelerated tests such as burn-in, temperature cycling and HAST for assessing system reliability. |

**UNIT - I**
Basic concepts of Reliability: Failures and faults, Reliability and failure rate, Relation between reliability & mean time between failure, Maintainability & Availability, reliability of series and parallel systems. Modeling of faults. Test generation for combinational logic circuits : conventional methods (path sesitisation, Boolean difference), Random testing, transition count testing and signature analysis.

**UNIT - II**
Fault Tolerant Design-I: Basic concepts, static, (NMR, use of error correcting codes), dynamic, hybrid and self purging redundancy, Siftout Modular Redundancy (SMR), triple modular redundancy, 5MR reconfiguration.

**UNIT - III**
Fault Tolerant Design-II: Time redundancy, software redundancy, fail-soft operation, examples of practical fault tolerant systems, introduction to fault tolerant design of VLSI chips.

**UNIT - IV**
Self checking circuits: Design of totally self checking checkers, checkers using m-out of a codes, Berger codes and low cost residue code, self-checking sequential machines, partially self-checking circuits. Fail safe Design: Strongly fault secure circuits, fail-safe design of sequential circuits using partition theory and Berger codes, totally self checking PLA design.

**UNIT - V**
Design for testable combination logic circuits: Basic concepts of testability, controllability and observability. The Read-Muller expansion technique, level OR-AND-OR design, use of control and syndrome-testing design. Built-in-test, built-in-test of VLSI chips, design for autonomous self-test, design in testability into logic boards.

**Suggested Reading:**

1. Parag K. Lala, *Fault Tolerant & Fault Testable Hardware Design*, (PHI) 1985
2. Parag K. Lala, *Digital systems Design using PLD's*, PHI 1990.
3. N.N. Biswas, *Logic Design Theory*, PHI 1990.
4. Konad Chakraborthy & Pinaki Mazumdar, Fault tolerance and Reliability Techniques for high – density random – access memories Reason, 2002.

# SPEECH PROCESSING
# (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4200 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To understand the mechanism of speech production.<br>• To analyze various speech synthesizers<br>• To study various types of coders and decoders<br>• To analyze speaker identification and verification systems | **At the end of the course students will be able to:**<br>• Apply the knowledge of science to design an artificial model of speech production system.<br>• Analyse the types of speech signal & convert the signal in to digital.<br>• Synthesize the speech signal using a text as input. Also design an ASR by pattern matching method.<br>• Design speech encoder and decoder.<br>• Identify and acquire knowledge about different types of transformation. |

**UNIT - I**
Mechanism of speech production, source filter model of speech production, speech sounds. Differential PCM. Adaptive delta modulation, Adaptive differential PCM (ADPCM).
Short time spectral analysis, cepstral analysis, Auto correlation function, Linear predictive analysis, pitch synchronous analysis.

**UNIT - II**
Short –time Energy function, zero crossing rate, End point detection, vector quantization. Format Tracking; Pitch extraction.

**UNIT - III**
Format synthesizer; Linear predictive synthesizer, phone use synthesis, Introduction to Text-to-speech and Articulator speech synthesis.

**UNIT - IV**
Sub-band coding, Transforms coding, channel decoder, Formant decoder, cepstral decoder, linear predictive decoder, vector quantizer coder.

**UNIT - V**
Problems in Automatic speech recognition, Dynamic warping, Hidden Markow models, speaker Identification / verification.

**Suggested Reading:**

1. Daniel Jurefskey & James H. Martin, “*Speech and Language Processing*”, Pearson Education, 2003.
2. Rabiner and Schafer, “*Digital Processing of Speech Signals*”, PHI, 1978.
3. Owens F.J., “*Signal Processing of Speech*”, Macmillan, 2000.
4. Papamchalis, “*Practical Approaches to speech coding*”, PHI, 1987.

# WIRELESS SENSOR NETWORKS
# (ELECTIVE –II)

| Subject Code : EC 4210 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
|---|---|---|
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Differentiate WSNs and mobile ad-hoc networks and illustrate the single node computational blocks and design challenges narrating WSN fundamental entities.<br>• Analyze and Summarize the MAC (L-2) and Routing (L-3) protocols along with the physical transceiver radio design.<br>• Describe WSN topology, localization along with existing hardware support and software simulators and programming models. | **At the end of the course students will be able to:**<br>• Synthesize Wireless Sensor Network Characteristics and its challenges; and, differentiate WSN with other ad-hoc networks.<br>• Illustrate architecture of Single WSN mote with Energy consumption mathematical models of a single mote both during the transmission and reception.<br>• Differentiate Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks and their comparisons<br>• Study different topology control and clustering schemes with localization concepts.<br>• Mention some of the widely used WSN simulation tools and platforms with engineering case studies. |

**UNIT - I**
**OVERVIEW OF WIRELESS SENSOR NETWORKS:** Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks

**UNIT - II**
**ARCHITECTURES:** Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

**UNIT - III**
**NETWORKING SENSORS:** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, Zigbee: IEEE 802.15.4 MAC Layer, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

**UNIT - IV**
**INFRASTRUCTURE ESTABLISHMENT:** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

**UNIT - V**
**SENSOR NETWORK PLATFORMS AND TOOLS:** Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

**Suggested Reading:**
1. Holger Karl and Andreas Willig, "*Protocols And Architectures for Wireless Sensor Networks*," John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, "*Wireless Sensor Networks - An Information Processing Approach*," Elsevier, 2007.
3. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "*Wireless Sensor Networks- Technology, Protocols and Applications*," John Wiley, 2007.
4. Anna Hac, "*Wireless Sensor Network Designs*," John Wiley, 2003.

# POWER ELECTRONICS
# (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4220 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Get an overview of different types of power semi-conductor devices and their switching characteristics.<br>• Understand the operation, characteristics and performance parameters of controlled rectifiers.<br>• Study the operation, switching techniques and basic topologies of DC-DC switching regulators.<br>• Learn the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.<br>• Study the operation of AC voltage controller and Matrix Converters. | **At the end of the course students will be able to:**<br>• Identify the need and methods for power conversion and control of electrical energy to match the load requirements.<br>• Analyze and compare the characteristics of an ideal switch with practically available power electronic devices.<br>• Analyze steady state performance of different types of converters such as AC to DC, DC to AC and DC to DC converters. |

**UNIT - I**

Introduction, Applications of power electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits, Peripheral effects.

**POWER TRANSISTOR:** Power BJT's, Switching characteristics, Switching limits, Base derive control, Power MOSFET's, Switching characteristics, Gate drive, IGBT's, Isolation of gate and base drives.

**UNIT - II**

**INTRODUCTION TO THYRISTORS:** Principle of operation states, anode - cathode characteristics, two transistor model. Turn-on Methods, Dynamic Turn-on and turn-off characteristics, Gate characteristics, Gate trigger circuits, di / dt and dv / dt protection, Thyristor firing circuits.

**UNIT - III**

**CONTROLLED RECTIFIERS:** Introduction, Principles of phase controlled converter operation, 1φ fully controlled converters, Duel converters, 1 φ semi converters (all converters with R & RL load).

Thyristor turn off methods, natural and forced commutation, self commutation, class A and class B types,

**UNIT - IV**

Complementary commutation, auxiliary commutation, external pulse commutation, AC line commutation, numerical problems.

**AC VOLTAGE CONTROLLERS:** Introduction, Principles of on and off control, Principles of phase control, Single phase controllers with restive loads and Inductive loads, numerical problems.

**UNIT - V**

**DC CHOPPERS:** Introduction, Principles of step down and step up choppers, Step down chopper with RL loads, Chopper classification, Switch mode regulators – buck, boost and buck – boost regulators.

**INVERTORS:** Introduction, Principles of operation, Performance parameters, 1φ bridge inverter, voltage control of 1φ invertors, current source invertors, Variable DC link inverter.

**Suggested Reading:**

1. Power Electronics - M. H. Rashid 3rd edition, PHI / Pearson publisher 2004.
2. Power Electronics - M. D. Singh and Kanchandani K.B. TMH publisher, 2nd Ed. 2007.
3. Power Electronics, Essentials and Applications", L Umanand, John Wiley India Pvt. Ltd, 2009.
4. Power Electronics, Daniel W. Hart, McGraw Hill, 2010.
5. Power Electronics, V Nattarasu and R.S. Anandamurhty, Pearson/Sanguine Pub. 2006.

# BIOMEDICAL SIGNAL PROCESSING
# (ELECTIVE –II)

| | | |
|---|---|---|
| Subject Code : EC 4230 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To introduce the fundamentals of probability theory and random processes with biomedical signals applications.<br>• To equip students with the fundamental tools that are used to describe, analyze and process biomedical signals.<br>• To acquire the knowledge on fundamental principles in the analysis and design of filters, power spectral density estimation and non-stationary signal processing techniques with cardiological and neurological signals . | **At the end of the course students will be able to:**<br>• To knowledgable of the probability theory and random processes techniques in analyzing biological signals.<br>• Determine to best class of compression techniques to use for a particular signal.<br>• Possess the basic mathematical, scientific and computational skills necessary to analyze cardiological signals.<br>• Ability to formulate and solve basic problems in biomedical signal analysis is enhanced.<br>• Possess the basic mathematical, scientific and computational skills necessary to analyze neurological signals. |

**UNIT - I**

**Discrete and continuous Random variables**: Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables.
Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems.

**UNIT - II**

**Data Compression Techniques:** Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantisation, DCTand the K L transform.

**UNIT - III**

**Cardiological Signal Processing**: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia Detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis.
Adaptive Noise Cancelling: Principles of Adaptive Noise Cancelling. Adaptive Noise Cancelling with the LMS Adaptation Algorithm. Noise Cancelling Method to Enhance ECG Monitoring. Fetal ECG Monitoring.

**UNIT - IV**

**Signal Averaging, polishing** – mean and trend removal, Prony’s method, Prony's Method based on the Least Squares Estimate, Linear prediction. Yule – walker (Y –W) equations, Analysis of Evoked Potentials.

**UNIT - V**

**Neurological Signal Processing**: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.

**Suggested Reading:**

1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, $4^{th}$ ed., 2009, TMH.
2. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, 2005,TMH.
3. Digital Bio signal Processing - Weitkunat R, 1991, Elsevier.
4. Biomedical Signal Processing - Akay M , IEEE Press.
5. Biomedical Signal Processing -Vol. I Time & Frequency Analysis - Cohen.A, 1986, CRC Press.
6. Biomedical digital Signal Processing: C-Language Experiments and Laboratory Experiments, willis J.Tompkins, PHI.

# RADAR AND NAVIGATIONAL SYSTEMS
## (Elective – II)

| | | |
|---|---|---|
| Subject Code : EC 4240 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Understand and apply radar range equation for prediction of range performance<br>• Study Doppler effect principles for CW&FM radars<br>• Study sequential lobing conical scan lobing and monopulse tracking radar techniques.<br>• Understand principles of navigation and positioning methods.<br>• Analyze direction finding methods and principles of landing systems. | **At the end of the course students will be able to:**<br>• Apply the knowledge of radar range equation for prediction of range performance<br>• Estimate target velocity, range and height using Doppler effect<br>• Choose the tracking radar for the given application<br>• Apply Dead reckoning and hyperbolic navigation methods<br>• Choose different direction finding methods and landing systems. |

**UNIT - I**

Radar Systems: Description of basic radar system and its elements, Radar equation, Block diagram and operation of a radar, Application of radar, Prediction of range performance, S/N ratio, False alarm time and probability of false alarm, Integration of radar pulses, Radar cross-section of a target, Pulse repetition frequency and range ambiguities, system losses.

**UNIT - II**

CW and FM radars: Doppler effects, CW radar, FMCW radar, Multiple frequency CW radar, A-scope, PPI displays.

MTI and Pulse Doppler radar: MTI radar, Delay line canceller, Multiple and staggered PRF, blind speeds, sub-clutter visibility, Cancellation ratio, Target visibility factor, MTI using gates and filters, Pulse Doppler radar, Non-coherent radar.

**UNIT - III**

Tracking radar: sequential lobing, Conical scan lobing, Monopulse: Amplitude comparison and phase comparison methods,

Radar antennas: Antenna parameters – Parabolic reflector antenna, Cassegrain antenna and cosecant-squared antenna pattern.

**UNIT - IV**

Dead reckoning: Introduction to navigation, Principles of dead reckoning, True north, Magnetic north, Great circle and rhumbline courses, Heading, Track, True air speed, Ground speed, Principles of gyros, Accelerometers, and Inertial navigation. Introduction to Doppler navigation.

Hyperbolic navigation: Introduction to hyperbolic navigation systems, LORAN-A and LORAN-C systems, Decca system and OMEGA system.

**UNIT - V**

Introduction to Direction finding, analysis of loop antenna for direction finding, Sense finder, increasing the sensitivity of direction finder, errors in direction finding, automatic direction finders, Non-directional beacon system. Principles of conventional VOR, CVOR antennas, Transmitting and receiving equipment, errors in CVOR, Doppler VOR system, Principles of distance measuring equipment, DME transmissions and airborne DME interrogator, Introduction to TACAN.

Introduction to GPS. Introduction to Landing systems, ILS, Antennas for ILS, Site effects of ILS.

**Suggested Reading:**

1. Skolnik M.I., Introduction to Radar Systems, 2nd edition, McGraw Hill, 1981.
2. N.S. Nagaraj, Elements of Electronic Navigation, Tata McGraw Hill, 1975.
3. A.K. Sen and A.B. Bhattacharya, Radar Systems and Radar Aids to Navigation, Khanna Publication, 1988.
4. M. Kulkarni ; Microwave and Radar Engineering, 1st edition, Umesh publications, 1998.
5. Albert Helfrick, Modern Aviation Electronics, Prentice Hall of India, 1984.

# NANO TECHNOLOGY
# (ELECTIVE –III)

| | | |
|---|---|---|
| Subject Code : EC 4250 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Learning comprehension in basic principles of nanoscience and nanoscale engineering.<br>• To acquire knowledge in mathematical models and design of NMEMS.<br>• Understanding applications of nanotechnology to engineering and medical systems. | **At the end of the course students will be able to:**<br>• Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.<br>• Identify the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.<br>• Apply the electronic microscopy, scanning probe microscopy and electron microscopy techniques to characterize the nanomaterials and nanostructures.<br>• Understand mathematical models and design of NMEMS.<br>• Evaluate and analyze the mechanical properties of bulk nanostructured metals and alloys, nanocomposites and carbon nanotubes. |

**UNIT - I**
Introduction to Physics of the Solid State: Structure, Size dependence of properties, Crystal structures, Face-Centered cubic nanoparticles, Tetrahedrally Bondd semiconductor structures, Lattice Vibrations, energy Bands, Effective masses, Fermi surfaces, Localized particles, Donors, Acceptors and Deep Traps, Mobilitiy, Excitions. Introduction to Semiconducting Nanoparticles, Introduction to Quantum Dots, wells, Preparation of Quantum Nanostructures.

**UNIT - II**
TEM, Infraed and Raman spectroscopy. Phpotoemission and X-RAY spectroscopy, Electron microscopy, SPMs, AFMs, Elecrostatic force Microscope, Magnetic force microscope.

**UNIT - III**
Biological analogies of Nano and Micro-electromechanical systems (NMEMS)-Applications Fabrication of MEMS-assembling and packaging - applications of NMEMS.

**UNIT - VI**
Mathematical models and design of NMEMS-architecture-electromagnetic and its applications for Nano and Micro-electromechanical motion devices Molecular and Nano structure dynamics-molecular wires and molecular circuits.

**UNIT - V**
Carbon nanotubes and nano devices-structural design of nano and MEM actuators and sensors configurations and structural design of motion nano-and micro-structures. Introduction to Intelligent control of Nano and Microelectronical Systems.

**Suggestion Reading :**

1. G.Timp, "*Nanotechnology,*" Bell Labs, Murray Hill , NJ, USA.
2. Charles P. Poolem, "*Introduction to nanotechnology,*" Wiley International.
3. Eric Drexler, "*Nano Systems; Molecular machinery, manufacturing and computation,*" John Wiley and Sons.
4. Lyschevski and Sergey Edward, "*Nano and Microelectromechanical Systems: Fundamentals of Nano and Micro Engineering,*" CRC Press, 2000.

# GLOBAL POSITIONING SYSTEM
# (ELECTIVE –III)

| | | |
|---|---|---|
| Subject Code : EC 4260 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To study basics of mathematics and science related to GNSS constellations<br>• To understand the different coordinates for representation user position.<br>• To analyze the different errors of GPS<br>• To understand the GPS data formats for use of different applications<br>• To understand the operation of argmentation system. | **At the end of the course students will be able to:**<br>• Apply the knowledge of basic mathematics and science to understand the different GNSS constellations<br>• Use of different coordinate systems used in user position estimation<br>• Identifying the various errors of GPS.<br>• Interpret the GPS data for different applications.<br>• Importance of augmentation systems in various diversified applications. |

**UNIT - I**

GPS Fundamentals: GPS Constellation, Principle of operation, GPS Orbits, Orbits mechanics and satellite position determination, time references. Geometric dilution of precision : GDOP, VDOP, PDOP.

**UNIT - II**

Coordinate Systems: Geometry of ellipsoid, geodetic reference system. Geoids, Ellipsoid and Regional datum, WGS-84, IGS ECI, ECEF.
Various error sources in GPS: Satellite and Receiver clock errors, ephemeris error, atmospheric errors, the receiver measurement noise and UERE.

**UNIT - III**

GPS measurement: GPS signal structure, C/A and P-code and carrier phase measurement, position estimation with pseudo range measurement, Spoofing and antiSpoofing, GPS navigation, observation data formats.

**UNIT - VI**

GPS Augmentation systems: Principle of DGPS, Types of DGPS: LADPS, WADGPS.
Satellite Based Augmentation system (SBAS) : WAAS, GAGAN.
Ground Based Augmentation System (GBAS): LAAS.

**UNIT - V**

GPS Application: Surveying Mapping Marine, air and land Navigation, Military and Space Application. GPS Integration with GIS, INS, Pseudolite and Cellular.
New Satellite Navigation system; GLONASS, Galileo System.

**Suggestion Reading :**


1. Satheesh Gopi, "*Global positioning system: Principles and Application,*" TMH, 2005.
2. Pratap Misra and Per Enge, "*Global Positioning System Signals, Measurement, and Performance,*" Ganga- Jamuna Press, 2/e, Massachusetts, 2010.
3. B.Hofmann-Wellenhof, H.Lichtenegger, and J.Collins, "*GPS Theory and Practice,*" Springer Verlog, 2008.
4. Bradford W.Parkinson and James J. Spilker, "*Global Positioning system: Theory and Application,*" Vol.II, American Institution of Aeronautices and Astronautics Inc., Washington, 1996.

# NEURAL NETWORKS AND FUZZY LOGIC
(Elective - III)

| | | |
|---|---|---|
| Subject Code : EC 4270 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Describe learning algorithms of artificial neural networks.<br>• Summarize different architecture and training algorithms with Hopfield network.<br>• Illustrate different Fuzzy Relationship models and justify applications in designing fuzzy controllers. | **At the end of the course students will be able to:**<br>• Justify the importance of artificial neural network with different models<br>• Demonstrate feedback topology and different learning algorithms.<br>• Discuss architecture of neural network with Hopfield algorithm with notable applications.<br>• Elaborate Fuzzification and Defuzzification methods.<br>• Suggest design methodology for Fuzzy controllers. |

**UNIT - I**
Evolution of neural networks; Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline.

**UNIT - II**
Topology of Multi-layer perceptron, Backpropagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen's self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

**UNIT - III**
Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

**UNIT - IV**
Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment-Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy arithmetic; composition and inference; Considerations of fuzzy decision-making.

**UNIT - V**
Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

**Suggested Reading**:
1. Limin Fu, "*Neural Networks in Computer Intelligence*," McGraw Hill, 2003.
2. Fakhreddine O. Karray and Clarence De Silva., "*Soft Computing and Intelligent Systems Design, Theory, Tools and Applications*," Pearson Education, India, 2009.
3. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*," McGraw Hill,1995.
4. B.Yegnanarayana, "*Artificial Neural Networks*," PHI, India,2006.

# SPECTRAL ESTIMATION TECHNIQUES (ELECTIVE –III)

| | | |
|---|---|---|
| Subject Code : EC 4280 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Study stationary random processes and relate the Autocorrelation of a data sequence with its Power Spectral density<br>• Apply Forward and backward linear prediction techniques and obtain the relation between AR process and linear prediction<br>• Employ non-parametric methods like Bartlett, Welch and Blackman-Tukey to estimate power spectra and compare their computational requirements<br>• Study and employ parametric methods to model a given process as AR, MA or ARMA and estimate the power spectrum.<br>• Apply Eigen Analysis algorithms (like Pisarenko, MUSIC, ESPIRIT and Filter Banks) for high resolution spectral estimation. | **At the end of the course students will be able to:**<br>• Compute the Autocorrelation function (ACF) and Power spectral density (PSD) of a random process.<br>• Identify the relation between AR process parameters and linear prediction coefficients for a given data sequence<br>• Obtain the Power Spectrum of a given data sequence using non-parametric methods (including Bartlett, Welch and Blackman-Tukey) and assess the quality of the estimate<br>• Estimate the AR model parameters using parametric methods (including Yule-Walker and Burg) and compare their performance.<br>• Model a given process as AR, MA or ARMA and estimate the Power Spectrum<br>• Apply Eigen Analysis algorithms (like Pisarenko, MUSIC, ESPIRIT and Filter Banks) for estimating high resolution spectrum for a given data sequence |

**UNIT - I**

Random variable, Random processes, stationary random processes, statistical average, statistical averages for joint random processes, Discrete-Time Random signals, Time averages for a Discrete Time Random processes, Mean-Ergodic Process, Correlation Ergodic Processes, Power density Spectrum, Representation of a Stationary Random Processes, Rational power spectra, Relation between the filter parameters and autocorrelation.

**UNIT - II**

Forward and Backward linear prediction-Forward and Backward linear prediction, Relationship of an AR process to linear prediction, Solution of linear equations- The Levinson- Durbin algorithm, Wiener Filters-Wiener filters for Filtering and Prediction, FIR Wiener filter, Orthogonality Principle in linear Mean square Estimation, IIR Weiner Filter, Noncausal Weiner filter.

**UNIT - III**

Power Spectrum Estimation: Estimation of Spectra from finite duration observation of a signal. Periodogram. DFT in power spectrum estimation.

Non-parametric methods – Bartlett’s, Welch’s and Blackman-Tukey methods, Performance Characteristics of Nonparametric Power Spectrum Estimators, Computational requirements and performance characteristics.

**UNIT - IV**

Parametric methods – Relation between auto correlation sequence and model parameters. Methods for AR model parameters. Yule – Walker method, Burg method, unconstrained Least squares methods. Sequential estimation methods. Selection of AR model order, Moving average (MA) and ARMA models for Power spectrum estimation.

**UNIT - V**

Eigen Analysis algorithms for Spectrum estimation- Pisarenko's harmonic decomposition method. Eigen structure methods – Music and ESPIRIT. Order selection criteria. Filter Bank methods- Filter bank realization of the periodogram, Capon's minimum variance method.

**Suggested Reading:**


1. John G. Proakis and Dimitris G. Manolakis, "*Digital Signal Processing-Principles, Algorithms and Applications*," 4/e, Pearson/PHI, 2007.
2. D.G. Manolakis, Ingle and S.M. Kogon, "*Statistical and Adaptive Signal Processing,*" McGraw Hill, 2000.
3. John G. Proakis, Rader, et al, "*Algorithms for Statistical Signal Processing,*" Pearson Education, Asia Publishers, 2002.
4. Emmanuel Ifeachor and Barrie W. Jervis, "*Digital Signal Processing - A Practical Approach,*" Pearson, 2004.

# MULTI RATE SIGNAL PROCESSING
## (Elective - III)

| | | |
|---|---|---|
| Subject Code : EC 4290 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• Design of optimal FIR filters<br>• Multirate Signal Processing fundamentals and design of practical sampling rate converters, and applications<br>• Analysis of multirate filter banks and their applications<br>• wavelet transforms and digital filter implementation of wavelets and applications | **At the end of the course students will be able to:**<br>• learn the essential advanced topics in DSP<br>• have the ability to solve various types of practical applications that require the use of sampling rate converters<br>• be able to design multirate filter banks for applications such as sub band coding, transmultiplexers.<br>• Capable of designing wavelet filters and their implementation for practical applications |

**UNIT - I**

**Digital filters design:** Design of Optimal FIR filters, Structures for FIR filters realization, Review of IIR Filters Design using bilinear transformation Method and structures for IIR filters realization, Finite word length effects in IIR filter,.

**UNIT - II**

**Basics of multirate signal processing:** Down sampling, Up sampling, Relation between the Fourier transform of the input and output of the down sampling and up sampling, Representation of decimator and interpolator, Changing the sampling rate by noninteger factor, Multistage approach to sampling rate conversion, Design of practical sampling rate converters, Polyphase decomposition of decimator and interpolator, Oversampling ADC analysis, Application examples.

**UNIT - III**

**Multirate Filter banks:** Uniform DFT filter banks, Two channel quadrature mirror filter (QMF) bank, Filter bank structure, Analysis of two channel QMF filter bank. Design of linear phase perfect reconstruction QMF filters banks, Maximally decimated filter banks, Tree structured filter banks, Octave-band filter banks, Application examples.

**UNIT - IV**

**Wavelet transforms:** Time frequency representation of signals, short-time Fourier transform (STFT), Scaling functions and wavelets, Discrete wavelet transform (DWT), Multi-resolution analysis (MRA), Wavelet reconstruction

**UNIT - V**

**Wavelets implementation:** design of decomposition and reconstruction filters for Haar, and Daubechies wavelets, Digital filter implementation of wavelets, Application examples.

**Suggested Reading:**

1. K. Deergha Rao and MNS Swamy, “Digital Signal Processing”, Jaico Publishing House, 2012.
2. Sanjit K. Mitra, “Digital Signal Processing”, 3/e, Tata McGraw-Hill Edition, 2006.
3. P.P. Vaidyanathan, “Multirate Systems and Filter Banks”, Pearson Education, 2004.
4. Emmanuel C. Ifeachor & Barrie W. Jervis, “Digital Signal Processing”, 2/e Pearson Education, 2003.

# TELEMETRY AND TELECONTROL
## (Elective - III)

| | | |
|---|---|---|
| Subject Code : EC 4300 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To study telemetry principles<br>• To understand the different symbols and codes used for telemetry applications.<br>• To familiarize with different multiplexing schemes.<br>• To study satellite and optical telemetry applications | **At the end of the course students will be able to:**<br>• Demonstrate in-depth knowledge in Telemetry and Telecontrol systems Symbols and Codes Different multiplexers in telemetry Satellite and optical telemetry systems<br>• Analyze complex engineering problems critically in the domain of Telemetry and Telecontrol systems for conducting research.<br>• Solve engineering problems for feasible and optimal solutions in the core area of Telemetry and<br>• Apply appropriate techniques to complex engineering activities in the field of telemetry and telecontrol systems. |

**UNIT – I**

**TELEMETRY PRINCIPLES:** Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency, Power Line Carrier Communication.

**SYMBOLS AND CODES** Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Intersymbol Interference.

**UNIT - II**

**FREQUENCY DIVISION MULTIPLXED SYSTEMS:** FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL

**TIME DIVISION MULTIPLXED SYSTEMS:** TDM-PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM.Introduction, QAM, Protocols.

**UNIT – III**

**SATELLITE TELEMETRY:** General considerations, TT&C Service, Digital Transmission systems, TT&C Subsystems,Telemetry and Communications.

**UNIT – IV**

**OPTICAL TELEMETRY:** Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits,Coherent Optical Fiber Communication System.

**UNIT – V**

**TELECONTROL METHODS:** Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory –Example of a Telecontrol System.

**Suggested Reading:**

1. D. Patranabis, Telemetry Principles, Tata McGraw-Hill, 1999
2. Swoboda G., Telecontrol Methods and Applications of Telemetry and Remote Control, Reinhold Publishing Corp., London, 1991
3. Young R.E., Telemetry Engineering, Little Books Ltd., London, 1988
4. Gruenberg L., Handbook of Telemetry and Remote Control, McGraw Hill, New York, 1987.
5. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.

## GRAPH THEORY IN ENGINEERING APPLICATIONS
## (Elective - III)

| | | |
|---|---|---|
| Subject Code : EC 4310 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objective of this course is to:**<br>• To get familiarity with graphs, various graph algorithms used in engineering applications. | **At the end of the course students will be able to:**<br>• Identify graphs and their properties useful for engineering applications.<br>• Apply graphs based algorithm to solve engineering problems**.**<br>• Demonstrate the usefulness of graph theory to solve engineering problems. |

**UNIT - I**

Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, path & circuits, connected graphs, disconnected graphs and component, euler graphs, various operation on graphs, Hamiltonian paths and circuits, the traveling sales man problem.

**UNIT - II**

Trees and fundamental circuits, distance diameters, radius and pendent vertices, rooted and
binary trees, on counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph and a weighted graph, algorithms of primes , Kruskal and Dijkstra Algorithms.

**UNIT - III**

Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets , connectivity and separability, network flows Planer graphs, combinatorial and geometric dual: Kuratowski graphs, detection of planarity, geometric dual, Discussion on criterion of planarity, thickness and crossings.

**UNIT - IV**

Vector space of a graph and vectors, basis vector, cut set vector, circuit vector, circuit and cut set subspaces, Matrix representation of graph – Basic concepts; Incidence matrix, Circuit matrix, Path matrix, Cut-set matrix and Adjacency matrix.

**UNIT -V**

Coloring, covering and partitioning of a graph, chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem
Discussion of Graph theoretic algorithm wherever required.

**Suggested Reading:**

1. Deo, N, Graph theory with applications to Engineering and Computer Science, PHI
2. Robin J. Wilson, Introduction to Graph Theory, Pearson Education
3. Harary, F, Graph Theory, Narosa
4. Bondy and Murthy: Graph theory and application. Addison Wesley.
5. Geir Agnarsson, Graph Theory: Modeling, Applications and Algorithms, Pearson Education

# SATELLITE COMMUNICATION SYSTEMS
# (ELECTIVE –III)

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| Subject Code : EC 4320 | Instruction : 3 Periods per week | Sessionals Marks : 30 |
| SEM Exam Marks : 70 | SEM Exam Duration : 3 Hours | Credits: 03 |

| Course objectives | Course Outcomes |
|---|---|
| **The objectives of this course is to:**<br>• To understand the working principles of various satellites and their importance in global communication<br>• To acquire the knowledge on satellite sub systems and various factors affecting the function of communication satellite.<br>• To study the need of multiple access techniques and various protocols being used in satellite communications | **At the end of the course students will be able to:**<br>• able to understand the importance of satellite communication systems and various types of satellites<br>• able to explain satellite subsystems telemetry, tracking and command control.<br>• Able to describe purpose of special communication satellites, need of various multiple access techniques and achievements by India in satellite communication. |

**UNIT - I**
Evolution and growth of communication satellites, synchronous satellites, frequency allocation, orbits, orbital mechanism and kepeler's law and velocity, effects of orbital inclination, azimuth and elevation, coverage angle and slant range, eclipse, placements of a satellite in geo-stationery orbit.

**UNIT - II**
Space segment, stabilization, communication subsystems, Telemetry, tracking and command Attitude & orbital Control Systems, Power Systems, earth segment, earth station, large and small earth station antennas, parabolic reflectors, Newtmian assegrain and Gregorian feed arrangements, offset feed, HPAs and LNAs, redundancy configuration., Thermal System.

**UNIT - III**
System noise temperature and G/T ration, Basic RF link analysis, EIRP, C/N, Interference, attenuation due to rain, cross polarization, design of uplink and down link

**UNIT - IV**
Multiple access techniques, FDM-FM-FDMA, SCPC companded systems, TDMA frame structure, Frame efficiency, superframe structure, frame acquisition and synchronization, types of demand assignments, DAMA characteristics, SPADE.

**UNIT - V**
Special purpose communication satellites, DBS, INTELAST, INMARSAT, MSAT, VSAT, LEO, Global positioning system, Echo- Cancellation techniques, Protocols, HDLC, Satellite applications, Indian activities in satellite communication, APPLE, INSAT-1, INSAT-2.

**Suggested Reading**

1. Tri-T-ha, *Digital Satellite Communications*, $2^{nd}$ Edition, McGraw Hill, 1990.
2. Dr. D.C Agarwal, *Satellite Communications* $4^{th}$ Edition, Khanna Publishers, 1996
3. Timothy Pratt and Charles W. Bostan, *Satellite Communications*, 1986.