KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

# B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
# REGULATION – 2020
# AUTONOMOUS SYLLABUS
# CHOICE BASED CREDIT SYSTEM
# VII TO VIII SEMESTER CURRICULUM AND SYLLABI

## VISION:

To make the Department of Electronics and Communication Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

## MISSION:

To impart highly innovative and technical knowledge in the field of Electronics and Communication Engineering to the urban and unreachable rural student folks through Total Quality Education.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

**PEO 1:** To establish a strong foundation in Electronics and Communication Engineering necessary to formulate, model, analyze and solve real time problems.

**PEO 2:** To inculcate professional skills and life skills for placement or to pursue higher studies in the relevant fields.

**PEO 3:** To promote research and development activities and solve industrial problems with creative ideas.

**PROGRAM OUTCOMES:**

After going through the four years of study, the Electronics and Communication Engineering graduates will have the ability to

| POs | Graduate Attribute | Programme Outcome |
|---|---|---|
| 1 | Engineering knowledge | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 2 | Problem analysis | Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| 3 | Design/development of solutions | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| 4 | Conduct investigations of complex problems | Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions |
| 5 | Modern tool usage | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations |
| 6 | The engineer and society | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice |

| | | |
|---|---|---|
| 7 | Environment and sustainability | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| 8 | Ethics | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| 9 | Individual and team work | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| 10 | Communication | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| 11 | Project management and finance | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| 12 | Life–long learning | Recognize the need for, and have the preparation and ability to engage in independent and life–long learning in the broadest context of technological change. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

**PSO 1 :** Ability to make use of attained technical knowledge in the field of Electronics and Communication Engineering for successful career and qualifying in competitive examinations at the national level.

**PSO 2 :** Ability to develop workable solutions for real time challenges in Electronics and Communication Engineering.

## SEMESTER VII

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | EC1701 | Embedded and Real Time Systems[#] | PC | 5 | 3 | 0 | 2 | 4 |
| 2 | EC1702 | Optical Communication | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | GE1771 | Principles of Management | HS | 3 | 3 | 0 | 0 | 3 |
| 4 | | Professional Elective – III | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | | Professional Elective – IV | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | | Open Elective – II* | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7 | EC1711 | Advanced Communication Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **24** | **18** | **0** | **6** | **21** |

*****Course from the Curriculum of other UG programmes.
[#]Theory cum Laboratory Course

## SEMESTER VIII

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | | Online Course – II | OL | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 2 | EC1821 | Project Work | EEC | 16 | 0 | 0 | 16 | 8 |
| | | | **TOTAL** | **19** | **3** | **0** | **16** | **11** |

## PROFESSIONAL ELECTIVES (PEs)

### PROFESSIONAL ELECTIVE III (SEMESTER VII)

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | EC1731 | Ad hoc and Wireless Sensor Networks | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | EC1732 | CMOS Analog IC Design | PE | 3 | 3 | 0 | 0 | 3 |
| 3 | EC1733 | Cognitive Radio | PE | 3 | 3 | 0 | 0 | 3 |
| 4 | EC1734 | Multimedia Compression and Communication | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | EC1735 | Wireless Networks | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | GE1471 | Professional Ethics and Human Values | PE | 3 | 3 | 0 | 0 | 3 |
| 7 | GE1671 | Total Quality Management | PE | 3 | 3 | 0 | 0 | 3 |

### PROFESSIONAL ELECTIVE IV (SEMESTER VII)

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | EC1736 | Advanced Wireless Communication | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | EC1737 | Low power SoC Design | PE | 3 | 3 | 0 | 0 | 3 |
| 3 | EC1738 | Principles of Cryptography and Steganography | PE | 3 | 3 | 0 | 0 | 3 |
| 4 | GE1772 | Project Management and Finance | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | EC1739 | Satellite Communication | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | EC1740 | Soft Computing and Optimization Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 7 | EC1741 | Video Analytics | PE | 3 | 3 | 0 | 0 | 3 |
| 8 | EI1738 | Robotics and Automation | PE | 3 | 3 | 0 | 0 | 3 |

## OPEN ELECTIVE II (SEMESTER VII)

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **Offered to AIDS, CSE, IT, BT** | | | | | | | | |
| 1 | OEC171 | Biomedical Electronics | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | OEC174 | MEMS, NEMS and BIO-MEMS | PE | 3 | 3 | 0 | 0 | 3 |
| **Offered to CIVIL, MECH, BT** | | | | | | | | |
| 3 | OEC172 | Computer Communication Networks | PE | 3 | 3 | 0 | 0 | 3 |
| **Offered to all discipline** | | | | | | | | |
| 4 | OEC173 | Electronic Packaging and Testing | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | OEC175 | Semiconductor Devices | PE | 3 | 3 | 0 | 0 | 3 |
| **Offered to CIVIL, MECH, MTR, BT** | | | | | | | | |
| 6 | OEC176 | Telecommunication System Modeling and Simulation | PE | 3 | 3 | 0 | 0 | 3 |

**EC1701 EMBEDDED AND REAL TIME SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To learn the architecture and programming of ARM processor.
- To understand the concepts of embedded system design and analysis.
- To be exposed to the basic concepts of embedded programming.
- To learn the concepts of scheduling and operating systems.
- To be exposed the real time systems and sample case study.

**UNIT I ARM PROCESSOR AND PERIPHERALS 9**

ARM Architecture Versions - ARM Architecture - Instruction Set - Stacks and Subroutines – Features of the LPC 214X/LPC 4088 Family – Peripherals - The Timer Unit – Pulse Width Modulation Unit - Block Diagram of ARM9 and ARM Cortex M3 MCU.

**UNIT II INTRODUCTION TO EMBEDDEDSYSTEM DESIGN 9**

Complex systems and microprocessors - Embedded system design process - Design example: Model train controller - Design methodologies - Design flows - Requirement Analysis - Specifications - System analysis and architecture design.

**UNIT III EMBEDDED PROGRAMMING AND PROCESSES 9**

Components for embedded programs - Models of programs - Assembly, linking and loading - compilation techniques - Program level performance analysis - Software performance optimization - Program level energy and power analysis and optimization - Analysis and optimization of program size - Program validation and testing.

**UNIT IV OPERATING SYSTEMS 9**

Introduction - Multiple tasks and multiple processes - Multirate systems - Preemptive real-time operating systems - Priority based scheduling - Interprocess communication mechanisms - Evaluating operating system performance - Power optimization strategies for processes.

**UNIT V REAL TIME SYSTEMS AND CASE STUDIES 9**

Structure of a Real Time System - Estimating program run times - Task Assignment and Scheduling Case studies - Software Modem, Data Compressor & Audio player.

**TOTAL: 45 PERIODS**

**OUTCOMES (for Theory)**

**CO1:** Describe the architecture and programming of ARM processor.

**CO2:** Outline the concepts of embedded systems.

**CO3:** Explain the basic concepts of embedded programming.

**CO4:** Elucidate the concepts of scheduling and operating systems.

**CO5:** Model real–time applications using embedded–system concepts.

**TEXT BOOKS**


1. Marilyn Wolf, 2012. *Computers as Components - Principles of Embedded Computing System Design*, Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier).
2. Jane W.S.Liu, 2003. *Real Time Systems*, Third Indian Reprint, Pearson Education.


**REFERENCE BOOKS**


1. Andrew N. Sloss, 2004. *ARM System Developer's Guide: Designing and Optimizing System Software*, Elsevier.
2. Lyla B. Das, 2013. *Embedded Systems: An Integrated Approach*, Pearson Education.
3. Jonathan W. Valvano, 2012. *Embedded Microcomputer Systems Real Time Interfacing*, Third Edition, Cengage Learning.
4. David. E. Simon, 2007. *An Embedded Software Primer*, 1st Edition, Fifth Impression, Addison–Wesley Professional.
5. Raymond J.A. Buhr, Donald L.Bailey, 1999. *An Introduction to Real–Time Systems – From Design to Networking with C/C++*, Prentice Hall.
6. C.M. Krishna, Kang G. Shin, 1997. *Real–Time Systems*, International Editions, McGraw Hill.

7. K.V.K.K.Prasad, 2005. *Embedded Real–Time Systems: Concepts, Design & Programming*, Dream Tech Press.
8. Sriram V Iyer, Pankaj Gupta, 2004. *Embedded Real Time Systems Programming*, Tata McGraw Hill.

**LIST OF EXPERIMENTS**

1. Study of ARM evaluation system
2. Interfacing Switches and LEDs
3. Interfacing ADC using temperature sensor
4. Programming of DAC Module
5. Display the data in LCD
6. Programming of Stepper motor using delays
7. Mini project based on any Microprocessor/ Micrcontroller

**TOTAL: 30 PERIODS**

**EQUIPMENTS NEEDED (FOR 30 STUDENTS)**

| S.NO. | NAME OF THE EQUIPMENT | QTY. |
|---|---|---|
| 1 | Embedded trainer kits with ARM board | 10 Nos |
| 2 | Adequate quantities of Hardware, software and consumables | – |

**OUTCOMES (for Laboratory)**

**CO1:** Build ARM based embedded C program in Microkeil environment.

**CO2:** Experiment with temperature sensor using analog to digital conversion.

**CO3:** Model DAC conversion in the ARM system .

**CO4:** Develop IO programming in ARM system to interface LCD .

**CO5:** Build IO programming in ARM system to rotate stepper motor with delays.

**EC1702** **OPTICAL COMMUNICATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To recognize and classify the structures of Optical fiber and types.
- To understandthe issues in propagation of light through fiber.
- To classify the Optical sources and calculate various coupling losses.
- To Classify detectors and to design a fiber optic link.
- To Familiar with concepts of WDM, optical amplifiers and Soliton Propagation.

**UNIT I INTRODUCTION TO OPTICAL FIBERS 9**

Element of an Optical Fiber Transmission link - Optical Fibers: Structure, Wave guiding - Step index and Graded index optical fiber - Modal analysis - Classification of modes - Single Mode Fibers.

**UNIT II SIGNAL DEGRADATION IN OPTICAL FIBER 9**

Attenuation - Absorption, Scattering and Bending losses. Dispersion - Material and Waveguide dispersion - Polarization Mode Dispersion - Dispersion Shifted Fibers - Dispersion Compensating Fibers.

**UNIT III OPTICAL SOURCES 9**

Optical sources: LEDs and Laser Diodes. Optical Power Launching and Coupling: Source to Fiber coupling - Schemes for coupling improvement - Fiber to Fiber joints - Fiber Splicing.

**UNIT IV OPTICAL DETECTORS 9**

Optical detectors: PIN and Avalanche photodiodes, Photo detector noise, Optical receivers. Digital link design: Power budget and Rise time budget.

**UNIT V OPTICAL COMMUNICATION SYSTEMS 9**

WDM Concepts - Optical Amplifiers: EDFA - Nonlinear effects: Self Phase Modulation, Nonlinear Schrodinger Equation - Optical Soliton.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Illustrate the various elements of fiber optics transmission link.

**CO2:** Demonstrate and calculate various losses and signal distortion.

**CO3:** Describe the fiber optics sources and various coupling techniques.

**CO4:** Explain the concept of working of optical receivers and identify the type of receiver for different links.

**CO5:** Explain the concepts of WDM, optical amplifiers and Soliton Propagation.

**TEXT BOOKS**


1. Gerd Keiser, 2013. *Optical Fiber Communication*, Fifth Edition, McGraw Hill International, Singapore.
2. John M. Senior, 2007. *Optical Fiber Communication*, Second edition, Pearson Education.


**REFERENCE BOOKS**


1. P Chakrabarti, 2016. *Optical Fiber Communication*, McGraw Hill Education (India) Private Limited.
2. Rajiv Ramaswami, 2004. *Optical Networks*, Second Edition, Elsevier.
3. J.Gower, 2001. *Optical Communication System*, Prentice Hall of India.
4. Govind P. Agrawal, 2004. *Fiber–optic communication systems*, Third edition, John Wiley & sons.

**GE1771 PRINCIPLES OF MANAGEMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To give a basic idea about the need of management principles in all kinds of organization.
- To understand the managerial functions like planning, organizing, staffing, Directing and controlling.
- To gain some knowledge about different structures of organization.
- To understand the role played by leader in different levels, and to understand the qualities, skills required for the leader while leading a team globally.
- To gain some knowledge about international management.

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS** **9**

Definition of Management - Nature, Scope and Functions of Management - Evolution of Management - Contributions of FW Taylor (14 principles of Management), Henri Fayol, Elton Mayo, Roethilisberger, H.A.Simon and P.F Drucker - Management theories - Science or Art - Manager Vs Entrepreneur - types of managers, managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Current trends and issues in Management.

**UNIT II PLANNING** **9**

Nature and purpose of planning - Planning process - Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

**UNIT III ORGANISING** **9**

Nature and purpose - Formal and informal organization - Organization chart - Organization structure - Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

**UNIT IV DIRECTING** **9**

Directing meaning - importance - principles of directing - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership -

types and theories of leadership - Communication - Process of communication, types of communication and its uses - Barrier in communication - Effective Communication - Communication and IT.

**UNIT V CONTROLLING 9**

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of computers and IT in Management control - Productivity problems and management - Inventory Management - PERT, CPM - Application - Control and performance - Direct and preventive control.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the trends and challenges of management in global scenario, the different types of organization and its effectiveness.

**CO2:** Utilize the strategies and policies which are involved in planning, Steps involved in the process of planning and use it for decision.

**CO3:** Identify the structure, purpose, selection and recruitment process in organizations.

**CO4:** Explain the various motivational theories and processes of management including its functions.

**CO5:** Compare and contrast the various control techniques.

**TEXT BOOKS**


1. Harold Koontz & Heinz Weihrich, 1998. *Essentials of Management*, Tata McGraw Hill.
2. Stephen P. Robbins & Mary Coulter, 2009. *Management*, 10th Edition, Prentice Hall (India) Pvt. Ltd.


**REFERENCE BOOKS**


1. Robert Kreitner & Mamata Mohapatra, 2008. *Management*, Biztantra.
2. Stephen A. Robbins, David A. Decenzo & Mary Coulter, 2011. *Fundamentals of Management*, 7th Edition, Pearson Education.
3. Tripathy PC & Reddy PN, 1999. *Principles of Management*, Tata McGraw Hill.

**EC1711 ADVANCED COMMUNICATION LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- To understand the working principle of optical sources, detector, fibers.
- To develop understanding of simple optical communication link.
- To understand the measurement of BER, Pulse broadening.
- To understand and capture an experimental approach to digital wireless communication.
- To understand actual communication waveforms that will be sent and received across wireless channel.

**LIST OF EXPERIMENTS**

**I. LIST OF OPTICAL EXPERIMENTS**

1. Measurement of connector, bending and fiber attenuation losses
2. Numerical Aperture and Mode Characteristics of Fibers
3. DC Characteristics of LED and PIN Photo diode
4. Fiber optic Analog and Digital Link Characterization – frequency response(analog), eye diagram and BER (digital)

**II. LIST OF WIRELESS COMMUNICATION EXPERIMENTS**

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios
4. OFDM Signal Transmission and Reception using Software Defined Radios

**III. LIST OF MICROWAVE EXPERIMENTS**

1. VSWR and Impedance Measurement and Impedance Matching
2. Characterization of Directional Couplers, Isolators, Circulators
3. Gunn Diode Characteristics
4. Microwave IC –Filter Characteristics

**TOTAL: 60 PERIODS**

## EQUIPMENTS NEEDED (FOR 30 STUDENTS)

| S.NO. | NAME OF THE EQUIPMENT | QTY. |
|---|---|---|
| 1 | Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, Optical power meter. | 2 Nos |
| 2 | Trainer kit for determining the mode characteristics, losses in optical fiber | 2 Nos |
| 3 | Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope. | 2 Nos |
| 4 | Kit for measuring Numerical aperture and Attenuation of fiber. | 2 Nos |
| 5 | Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement, Pulse broadening. | 2 Nos |
| 6 | MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors. | 2 sets |
| 7 | LEDs with ST / SC / E2000 receptacles – 650 / 850 nm | 2 sets |
| 8 | PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm | 2 sets |
| 9 | Digital Communications Teaching Bundle (LabVIEW/MATLAB/Equivalent software tools) | 10 Users |
| 10 | Transmit / receive pair of NI USRP–2920 transceivers (50 MHz to 2.2 GHz). | 2 Nos |

**OUTCOMES**

**CO1:** Analyze the performance of simple optical link by measurement of losses and Analyzing the mode characteristics of fiber.

**CO2:** Analyze the eye pattern, pulse broadening of optical fiber and the impact on BER.

**CO3:** Simulate the wireless channel characteristics and its impairments.

**CO4:** Analyze the transmission and reception of wireless system using SDR.

**CO5:** Demonstrate the intricacies in Microwave System design.

**EC1821** **PROJECT WORK**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 16 | 8 |

**OBJECTIVES:**

- To impart required knowledge related to the project.
- To analyze the realtime problem with an indepth study from available literature in the selected domain.
- To understand the methodology used to solve the problem.
- To apply the engineering knowledge in the project domain.
- To discuss results with experimental outputs of hardware/ software implementation.

The Students in a group of 3 or 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The review progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 240 PERIODS**

**OUTCOMES**

**CO1:** Identify a potential problem based on literature Survey/impending industrial/real time needs.

**CO2:** Categorize various solution methodologies to solve Problem taken for study.

**CO3:** Design and develop proposed solution relevant to the Problem.

**CO4:** Analyze design/experimental results based on hardware & software implementation.

**CO5:** Analyze and recommend solution to potential engineering problems based on results and conclusion.

**EC1731 AD HOC AND WIRELESS SENSOR NETWORKS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn Ad hoc network and Sensor Network fundamentals.
- To understand the different routing protocols.
- To enable an in depth knowledge on sensor network architecture and design issues.
- To study the transport layer and security issues possible in Ad hoc and Sensor networks.
- To know an exposure to mote programming platforms and tools.

**UNIT I AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS** **9**

Introduction - Ad Hoc Wireless Networks, Application of Ad Hoc Wireless Networks, Issues in Ad hoc wireless networks, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols - Ad hoc On-Demand Distance Vector Routing (AODV).

**UNIT II SENSOR NETWORKS – INTRODUCTION AND ARCHITECTURES** **9**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single - Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Design Principles of WSN, Optimization Goals and Figures of Merit.

**UNIT III WSN NETWORKING CONCEPTS AND PROTOCOLS** **9**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols - LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

**UNIT IV SENSOR NETWORK SECURITY 9**

Network Security fundamentals, Security Consideration in WSNs, Network Security Attacks - Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing - SPINS, reliability requirements in sensor networks.

**UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9**

Sensor Node Hardware - Berkeley Motes, Programming Challenges, Node-level software platforms - TinyOS, nesC, CONTIKIOS, Node-level Simulators - NS2, NS3 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes - State centric programming.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Infer about the network architectures, Issues & design challenges and routing protocols of ad hoc and wireless sensor networks.

**CO2:** Outline the challenges, enabling technologies and architecture for wireless sensor networks.

**CO3:** Interpret the MAC and routing protocols for wireless sensor networks with respect to some protocol design issues.

**CO4:** Summarize the different attacks and secure routing for sensor networks.

**CO5:** Illustrate the sensor level hardware and node level simulators used to design the sensor networks.

**TEXT BOOKS**

1. C. Siva Ram Murthy and B.S.Manoj, 2004. *Ad Hoc Wireless Networks Architectures and Protocols*, Prentice Hall, PTR.
2. Holger Karl and Andreas willig, 2006. *Protocol and Architecture for Wireless Sensor Networks*, John Wiley Publication.

**REFERENCE BOOKS**

1. Feng Zhao and Leonidas Guibas, 2004. *Wireless Sensor Networks: an information processing approach*, Elsevier publication.

2. Charles E. Perkins, 2000. *Ad Hoc Networking*, Addison Wesley.

3. I.F. Akyildiz, W. Su, Sankarasubramaniam and E. Cayirci, 2002. *Wireless sensor networks: a survey, computer networks*, Elsevier, 394–422.

**EC1732** **CMOS ANALOG IC DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To study the fundamentals of analog circuits and MOS device models.
- To gain knowledge on various configurations of MOS transistors and feedback concepts.
- To study the characteristics of noise and frequency response of the amplifier.
- To learn the concepts of Op–Amp frequency compensation.
- To learn the concepts of capacitor switches and PLLs.

**UNIT I INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS** **9**

Concepts of Analog Design - General consideration of MOS devices - MOS I/V Characteristics - Second order effects - MOS device models. Basic current mirrors - Cascode current mirrors - Active current mirrors - Large and Small signal analysis - Common mode properties.

**UNIT II AMPLIFIERS AND FEEDBACK** **9**

Basic Concepts - Common source stage - Source follower - Common gate stage - Cascode stage. Single ended and differential operation - Basic Differential pair - Common mode response - Differential pair with MOS loads - Gilbert Cell. Feedback - General Consideration of feedback circuits - Feedback topologies - Effect of loading - Effect of feedback on Noise.

**UNIT III FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE** **9**

General considerations - Miller Effect and Association of Poles with Nodes, Common source stage - Source followers - Common gate stage - Cascode stage - Differential pair. Noise - Statistical characteristics of noise - Types of noise - Representation of noise in circuits - Noise in single stage amplifiers - Noise in differential pairs - Noise Bandwidth.

**UNIT IV OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION** **9**

General Considerations - One and Two Stage Op Amps - Gain Boosting - Comparison - Common mode feedback - Input range limitations - Slew rate Power Supply Rejection - Noise in Op Amps - General consideration of stability and frequency compensation - Multipole system - Phase margin - Frequency compensation - Compensation of two stage op Amps - Other compensation techniques.

**UNIT V SWITCHED CAPACITOR CIRCUITS AND PLLS** **9**

General Considerations - Sampling switches - Switched Capacitor Amplifiers - Switched Capacitor Integrator - Switched Capacitor Common mode feedback. Phase Locked Loops - Simple PLL - Charge pump PLLs - Non ideal Effects in PLLs - Delay locked loops - its Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Realize the concepts of Analog MOS devices and current mirror circuits.

**CO2:** Design different configuration of Amplifiers and feedback circuits.

**CO3:** Analyze the characteristics of frequency response of the amplifier and its noise.

**CO4:** Analyze the performance of the stability and frequency compensation techniques of Op–Amp Circuits.

**CO5:** Construct switched capacitor circuits and PLLs.

**TEXT BOOKS**

1. Razavi, B, 2016. *Design of analog CMOS integrated circuits*. Tata McGraw–Hill Education.
2. Allen, P.E. and Holberg, D.R, 2011. *CMOS Analog Circuit Design*. Elsevier.

**REFERENCE BOOKS**


1. Gray, P.R, Hurst, P, Meyer, R.G, and Lewis, S, 2009. *Analysis and Design of Analog Integrated Circuits*. Wiley.
2. Grebene, A.B, 2003. *Bipolar and MOS analog integrated circuit design*. John Wiley & Sons.

**EC1733** **COGNITIVE RADIO**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities.
- To study the basic architecture and standard for cognitive radio.
- To enable the knowledge about the physical, MAC and Network layer design of cognitive radio.
- To expose the student to evolving applications and advanced features of cognitive radio.
- To introduce the recent technologies in cognitive radio.

**UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO AND COGNITIVE RADIO** **9**

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

**UNIT II COGNITIVE RADIO ARCHITECTURE** **9**

Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

**UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS** **9**

Introduction - Primary user detection techniques - energy detection, feature detection, matched filtering, cooperative detection, Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing - Kullback Leibler Divergence and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

**UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO** **9**

MAC for cognitive radios - Multichannel MAC - slotted ALOHA - CSMA, Network layer design - routing in cognitive radios, flow control and error control techniques.

**UNIT V ADVANCED TOPICS IN COGNITIVE RADIO** **9**

Cognitive radio for Internet of Things - Features and applications - Enabling Technologies and Protocols - M2M technologies - Data storage and analysis techniques - Requirements and Challenges of IoT - Energy efficiency - MIMO Cognitive Radio - Power allocation algorithms.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Interpret the architecture, design issues & Challenges of software defined radio & cognitive radio.

**CO2:** Illustrate the theoretical aspects of cognitive radio.

**CO3:** Summarize the different types of spectrum sensing & spectrum access of cognitive radio.

**CO4:** Compare MAC and network layer design for cognitive radio.

**CO5:** Infer about the advanced technologies in cognitive radio.

**TEXT BOOKS**


1. Alexander M. Wyglinski, Maziar Nekovee and Thomas Hou, 2010. *Cognitive Radio Communications and Networks*, Academic Press, Elsevier.
2. Huseyin Arslan (Ed.), 2007. *Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems*, Springer.


**REFERENCE BOOKS**


1. Bruce Fette, 2006. *Cognitive Radio Technology*, Newnes.
2. Kwang–Cheng Chen & Ramjee Prasad, 2009. *Cognitive Radio Networks*, John Wiley and Sons.

3. Ezio Biglieri, Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam & H. Vincent Poor, 2012. *Principles of Cognitive Radio*, Cambridge University Press.

**EC1734** **MULTIMEDIA COMPRESSION AND COMMUNICATION**

| L | T | P | C |
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| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the multimedia skills and components.
- To understand the compression schemes for audio and video.
- To understand the compression schemes for text and image.
- To understand the QoS issues in multimedia network.
- To know the communication protocols for multimedia networking.

**UNIT I MULTIMEDIA COMPONENTS 9**

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, audio, images, graphics, animation, video, hardware, Applications of multimedia systems.

**UNIT II AUDIO AND VIDEO COMPRESSION 9**

Audio compression - DPCM - Adaptive DPCM - adaptive predictive coding - linear Predictive coding code excited LPC - perpetual coding - Video compression principles - H.261, H.263, MPEG 4,5.

**UNIT III TEXT AND IMAGE COMPRESSION 9**

Compression principles - source encoders and destination encoders - lossless and lossy compression - entropy encoding - source encoding– text / image compression - static Huffman coding - dynamic Huffman coding - Arithmetic coding - Lempel Ziv - LZW.

**UNIT IV VOIP TECHNOLOGY 9**

Basics of IP transport, VoIP challenges, H.323/ SIP - Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service - CODEC Methods - VOIP applicability.

**UNIT V MULTIMEDIA COMMUNICATION 9**

Stream characteristics for Continuous media - Temporal Relationship - Object Stream Interactions, Media Levity, Media Synchronization - Models for Temporal Specifications - Streaming of Audio and Video - Jitter - Fixed playout and Adaptive playout - Recovering from packet loss - RTSP - Multimedia Communication Standards - RTP/RTCP.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the characteristic features of multimedia components.

**CO2:** Compare the various compression techniques for Audio & Video.

**CO3:** Solve encoding / decoding process of text and image using various compression techniques.

**CO4:** Illustrate suitable service model for VoIP technology.

**CO5:** Explain the protocol concepts of multimedia networking.

**TEXT BOOKS**


1. Fred Halsall 2007. *Multimedia Communication - Applications, Networks, Protocols and Standards*, Pearson education.
2. Kurose and W. Ross 2005. *Computer Networking - A Top Down Approach*, Pearson education, 3rd edition.


**REFERENCE BOOKS**


1. Tay Vaughan 2006. *Multimedia Making it work,* McGraw–Hill Osborne Media.
2. KR. Rao,Z S Bojkovic, D A Milovanovic 2007. *Multimedia Communication Systems: Techniques, Standards, and Networks*, Pearson Education.
3. R. Steimnetz, K. Nahrstedt 1995. *Multimedia Computing, Communications and Applications*, Pearson Education, First edition.
4. Nalin K Sharda 1999. *Multimedia Information Networking*, Prentice Hall of India.
5. Aura Ganz, ZviGanz and Kitti Wongth awaravat 2003. *Multimedia Wireless Networks:Technologies, Standards and QoS*, Prentice Hall.
6. Ellen Kayata Wesel 1998. *Wireless Multimedia Communications: Networking Video, Voice and Data*, Addision Wesley.

**EC1735** **WIRELESS NETWORKS**

| L | T | P | C |
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**OBJECTIVES:**

- To understand the concept about Wireless networks, protocol stack and standards.
- To understand and analyze the network layer solutions for Wireless networks.
- To study about fundamentals of 3G Services, its protocols and applications.
- To have in depth knowledge on internetworking of WLAN and WWAN.
- To learn about evolution of 4G Networks, its architecture and applications.

**UNIT I WIRELESS LAN 9**

Introduction - WLAN technologies: - IEEE802.11: System architecture, protocol architecture, Physical and MAC layer, 802.11b, 802.11a - Hiper LAN: WATM, BRAN, HiperLAN2 - Bluetooth: Architecture, WPAN - IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART.

**UNIT II MOBILE NETWORK LAYER 9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6 - Network layer in the internet - Mobile IP session initiation protocol - Mobile ad hoc network: Routing: Destination Sequence distance vector, Dynamic Source Routing, IoT: CoAP.

**UNIT III 3G OVERVIEW 9**

Overview of UTMS Terrestrial Radio access network - UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview - Radio and Network components, Network structure, Radio Network, TD–CDMA, TD – SCDMA.

**UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS 9**

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

**UNIT V 4G & BEYOND 9**

Introduction - 4G vision - 4G features and challenges - Applications of 4G - 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO, Introduction to Future Wireless Networks.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Outline the latest WLAN and WPAN networks and its architecture.

**CO2:** Develop wireless network environment for various applications using emerging wireless protocols and standards.

**CO3:** Explain the various Wireless Wide Area Networks, Protocol Stack, Architecture and Standards.

**CO4:** Explain the difference between the WWAN and WLAN.

**CO5:** Interpret the various 4G technologies.

**TEXT BOOKS**


1. Jochen Schiller, 2012. *Mobile Communications,* Pearson Education–Second Edition.
2. Garg, V, 2010. *Wireless Communications & Networking*. Elsevier.


**REFERENCE BOOKS**


1. Dahlman, E, Parkvall, S, Skold, J. and Beming, P, 2010. *3G evolution: HSPA and LTE for mobile broadband*. Academic press.
2. Anurag Kumar, D.Manjunath, Joy kuri, 2011. *Wireless Networking.* Elsevier–First Edition.
3. Haykin, S.S. & Moher, M, 2011. *Modern Wireless Communications*. Pearson Education India.

**GE1471 PROFESSIONAL ETHICS AND HUMAN VALUES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values.
- To impart Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES 9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue - Respect for others - Living peacefully – Caring – Sharing - Honesty – Courage - Valuing time – Cooperation –Commitment - Empathy – Self–confidence – Character - Spirituality – Stress management Techniques.

**UNIT II ENGINEERING ETHICS 9**

Senses of Engineering Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg‘s theory - Gilligan‘s theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self -interest - Customs and Religion - Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights – Employee Rights - Intellectual Property Rights (IPR) - Discrimination.

**UNIT V GLOBAL ISSUES 9**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Code of Conduct - Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Summarize the various Morals, Values, Ethics, Integrity and other Human Values.

**CO2:** Describe the Senses of Engineering ethics, its related Theories and Models of Professional Roles.

**CO3:** Explain the codes of Ethics for various Engineering Experiments.

**CO4:** Examine the various Risk, Safety and Risk Benefit Analysis for a Product/ Service in an Organization.

**CO5:** Explain the various Global Issues in Ethics and Review the Responsibilities and Rights of Professionals and Employees in an Organization.

**TEXT BOOKS**


1. Mike W. Martin and Roland Schinzinger, 2017. *Ethics in Engineering*, 4th Edition, McGraw Hill.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, 2004. *Engineering Ethics*, Prentice Hall of India.


**REFERENCE BOOKS**


1. Charles B. Fleddermann, 2012. *Engineering Ethics*, 4th Edition, Prentice Hall.
2. Charles E. Harris, Michael S. Pritchard, Raw W. James, Elaine E. Englehardt, and Michael J. Rabins, 2019. *Engineering Ethics – Concepts and Cases*, 12th Edition, Cengage Learning.
3. John R Boatright, Jeffery Smith, 2016. *Ethics and the Conduct of Business*, 8th Edition, Pearson Education.
4. Edmund G Seebauer and Robert L Barry, 2001. *Fundamentals of Ethics for Scientists and Engineers*, South Asia Edition, Oxford University Press.

**GE1671** **TOTAL QUALITY MANAGEMENT**

| L | T | P | C |
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**OBJECTIVES:**

- To learn the concepts of quality and quality management, TQM framework, Barriers and Benefits of TQM.
- To apply the Principles and techniques of Quality Management for real time.
- To understand the need and importance of quality assurance and certification.

**UNIT I INTRODUCTION** **9**

Concept of Quality and Quality Management– Determinants of quality of product & service – Quality vs. Reliability – Definition of TQM – Basic concepts of TQM – TQM Framework – Barriers to TQM – Benefits of TQM.– Gurus of TQM (Brief introduction) –Quality statements – vision, mission, Policy.

**UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT** **9**

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart – Concepts of Quality circle, Japanese 5S principles and 8D methodology.

**UNIT III TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT** **9**

Quality functions development (QFD) – Benefits, Voice of customer, information Organisation, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation – Taguchi technique.

**UNIT IV QUALITY COST AND CONTROL** **9**

Juran’s concept of quality cost – components of Quality Cost – Statistical Quality Control – Inspection, Sampling, Sample Size, Sampling Plan, AQL, OC curve, Producer Risk, Consumer Risk, AOQ, AOQL, Control Charts & Control Limits – X, R & S charts and their application– causes of variations – Assignable & Random; Runs –Test, Chart – Sensitivity Test and Run – Sum Test; Normal – Distribution curve and concept of Six Sigma.

**UNIT V QMS– QUALITY MANAGEMENT SYSTEM 9**

Introduction – Benefits of ISO Registration – ISO 9000 Series of Standards – Sector –Specific Standards – AS 9100, TS16949 and TL 9000 – ISO 9001 Requirements – Implementation – Documentation – Internal Audits – Registration – ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001– Requirements of ISO 14001– Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Apply TQM concepts in a selected enterprise.

**CO2:** Apply TQM principles in a selected enterprise.

**CO3:** Explain Taguchi's techniques, Performance Measures, QFD, HOQ.

**CO4:** Elucidate Six Sigma and apply Traditional tools, New tools, Benchmarking.

**CO5:** Confirm quality standards and implementing QMS in business organization.

**TEXT BOOKS**


1. L. Suganthi & Dr. Anand Samuel 2004. *Total Quality Management*, Prentice Hall, Publications.
2. Dale H.Besterfiled, Carol B.Michna, Glen H. Bester field, Mary B.Sacre, Hemant Urdhwareshe & Rashmi Urdhwareshe, 2013. *Total Quality Management*, Revised Third Edition, Indian Reprint, Sixth Impression, Pearson Education Asia.


**REFERENCE BOOKS**


1. Rose J.E. 1997. *Total Quality Management*, S. Chand & Co.
2. Kiran.D.R, 2016. *Total Quality Management: Key concepts and case studies*, Butterworth – Heinemann Ltd.
3. Shridhara Bhat K, 2016. *Total Quality Management: Text and Cases*, (2nd Edition), Himalaya Publishing House India, ISBN: 9789352622399.

**EC1736 ADVANCED WIRELESS COMMUNICATION**

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**OBJECTIVES:**

- To understand the importance of improving capacity of wireless channel using MIMO.
- To understand the radio wave propagation and fading measurements.
- To study channel impairment mitigation using space–time block codes.
- To understand the design of space time trellis codes on slow and fading channels.
- To understand the advanced MIMO system like layered space time codes, MU–MIMO System and MIMO–OFDM systems.

**UNIT I CAPACITY OF WIRELESS CHANNELS 9**

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity - channel known at the TX, Channel unknown to the TX – capacity of deterministic channels.

**UNIT II RADIO WAVE PROPAGATION 9**

Radio wave propagation – Macroscopic fading – free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding.

**UNIT III SPACE TIME BLOCK CODES 9**

Delay Diversity scheme, Alamouti space time code - Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation – decoding of STBC.

**UNIT IV SPACE TIME TRELLIS CODES 9**

Space time coded systems, space time code word design criteria, design of STTC on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

**UNIT V LAYERED SPACE TIME CODES 9**

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V – blast Rx – MMSE V-blast Rx, Iterative Rx – capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Comprehend the capacity improvement using multi antenna systems.

**CO2:** Characterize the radio wave propagation in a MIMO channel with impairments.

**CO3:** Explain the encoding and decoding of STBC.

**CO4:** Compare the space time block and trellis codes.

**CO5:** Outline the methods for improving the data rate of wireless communication system.

**TEXT BOOKS**


1. Mohinder Jankiraman, 2004. *Space–time codes and MIMO systems*, Artech House, Boston, London.
2. Paulraj Rohit Nabar, Dhananjay Gore, 2003. *Introduction of space time wireless communication systems*, Cambridge University Press.


**REFERENCE BOOKS**


1. David Tse & Pramod Viswanath, 2005. *Fundamentals of Wireless Communication*, Cambridge University Press.
2. Sergio Verdu, 1998. *Multi User Detection*, Cambridge University Press.

**EC1737** **LOW POWER SoC DESIGN**

| L | T | P | C |
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**OBJECTIVES:**

- To identify sources of power in integrated circuits.
- To understand basic principle of System on Chip design.
- To learn optimization of power in combinational and sequential logic machines for SoC Design.
- To identify suitable techniques to reduce the power dissipation and design circuits with low power dissipation.
- To learn the concepts of floor planning.

**UNIT I POWER CONSUMPTION IN CMOS 9**

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation – Designing for Low Power, Circuit Techniques for Leakage Power Reduction – Basic principle of low power design, Logic level power optimization – Circuit level low power design.

**UNIT II SYSTEM ON CHIP DESIGN 9**

System-on-Chip Concept, Design Principles in SoC Architecture, SoC Design Flow, Platformbased and IP based SoC Designs, Basic Concepts of Bus – Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies - Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma–delta ADC.

**UNIT III POWER OPTIMIZATION OF DIGITAL LOGIC MACHINES FOR SOC 9**

Introduction to Standard Cell - Based Layout - Simulation - Combinational Network Delay - Logic and interconnect Design - Power Optimization - Switch Logic Networks. Introduction - Latches and Flip-Flops - Sequential Systems and Clocking Disciplines - Sequential System Design - Power Optimization - Design Validation - Sequential Testing.

**UNIT IV** **DESIGN OF LOW POWER CIRCUITS FOR SUB SYSTEM ON A SOC** **9**

Subsystem Design Principles - Combinational Shifters - Adders - ALUs - Multipliers - High Density Memory - Field Programmable Gate Arrays - Programmable Logic Arrays - Computer arithmetic techniques for low power system - low voltage low power static random access and dynamic random access memories, low power clock, Inter connect and layout design.

**UNIT V** **FLOOR PLANNING** **9**

Floor-planning Methods - Block Placement & Channel Definition - Global Routing - switch box Routing - Power Distribution - Clock Distributions - Floor–planning Tips - Design Validation - Off Chip Connections - Packages, The I/O Architecture - PAD Design.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Outline the sources of power in integrated circuits.

**CO2:** Illustrate the basic principle of System on Chip design.

**CO3:** Develop an optimized power SoC design in combinational and sequential logic machines.

**CO4:** Identify suitable techniques to reduce the power dissipation and design circuits with low power dissipation.

**CO5:** Interpret the different techniques in floor planning.

**TEXT BOOKS**

1. A.Bellaowar & M.I.Elmasry, 1996. *Low Power Digital VLSI Design, Circuits and Systems*, Kluwer.

2. J.Rabaey, 2009. *Low Power Design Essentials (Integrated Circuits and Systems)*, Springer.

**REFERENCE BOOKS**


1. Wayne Wolf, 2008. *Modern VLSI Design – System– on–Chip Design*, Prentice Hall, 3rd Edition.
2. J.B.Kuo & J.H.Lou, 1999. *Low–voltage CMOS VLSI Circuit*, Wiley.

**EC1738** **PRINCIPLES OF CRYPTOGRAPHY AND STEGANOGRAPHY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn security mechanisms and techniques to provide security services.
- To learn mathematics for symmetric key cryptography and apply this concept in symmetric key Block ciphers.
- To learn mathematics for Asymmetric key cryptography and apply this concept in Asymmetric key ciphers.
- To understand the concept of different type of message authentication and Integrity.
- To be aware of the need for steganographic method.

**UNIT I INTRODUCTION 9**

Security trends - Legal, Ethical and Professional Aspects of Security, Need for security at Multiple levels, Security Policies - Model of network security - Security attacks, services and mechanisms - OSI security architecture - Classical encryption techniques: substitution techniques, transposition techniques, steganography - Foundation of modern cryptography: perfect security - information theory - product cryptosystem - cryptanalysis.

**UNIT II SYMMETRIC CRYPTOGRAPHY 9**

Mathematics of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic-Euclid‘s algorithm - Congruence and matrices - Groups, Rings, Fields - Finite fields - Symmetric Key Ciphers: DES - Block cipher Principles of DES - Strength of DES - Differential and linear cryptanalysis - Block cipher design principles - Block cipher mode of operation - Evaluation criteria for AES - Advanced Encryption Standard - RC4 - Key distribution.

**UNIT III PUBLIC KEY CRYPTOGRAPHY 9**

Mathematics of Asymmetric Key Cryptography: Primes - Primality Testing - Factorization - Euler‘s totient function, Fermat‘s and Euler‘s Theorem - Chinese Remainder Theorem - Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem - Key distribution - Key management - Diffie Hellman key exchange - ElGamal cryptosystem - Elliptic curve arithmetic - Elliptic curve cryptography.

**UNIT IV MESSAGE AUTHENTICATION AND INTEGRITY 9**

Authentication requirement - Authentication function - MAC - Hash function - Security of hash function and MAC - SHA – Digital signature and authentication protocols - DSS – Entity Authentication: Biometrics, Passwords, Challenge Response protocols - Authentication applications - Kerberos, X.509.

**UNIT V INTRODUCTION TO STEGANOGRAPHY 9**

Forms of Data Hiding - Properties of Steganographic Communication – Steganographic Channel - Data Hiding from a Communication Perspective – Hiding Information in Text – Hiding Information in Images – Watermarking Techniques.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Elucidate the fundamentals of network security, security architecture, threats and vulnerabilities.

**CO2:** Illustrate the DES & AES cryptographic operations of symmetric cryptographic algorithms.

**CO3:** Show the different cryptographic operations of public key cryptography.

**CO4:** Use the various authentication schemes to simulate different applications.

**CO5:** Explain the basics of Steganography and its techniques.

**TEXT BOOKS**

1. William Stallings, 2006. *Cryptography and Network Security: Principles and Practice*, PHI 3rd Edition.
2. Sencar, H.T, Ramkumar, M. and Akansu, A.N, 2004. *Data hiding fundamentals and applications: content security in digital multimedia*. Elsevier.

**REFERENCE BOOKS**

1. Behrouz A.Foruzan, 2007. *Cryptography and Network Security*, Tata McGraw Hill.

2. C K Shyamala, N Harini & Dr. T R Padmanabhan: *Cryptography and Network Security*, Wiley India Pvt.Ltd.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, *Network Security: PRIVATE Communication in a PUBLIC World*, Prentice Hall, ISBN 0–13–046019–2.

**GE1772 PROJECT MANAGEMENT AND FINANCE**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand what are the objectives of project management.
- To outline the principles followed in carrying out a project.
- To demonstrate knowledge and understanding of engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.
- To understand the concepts of finance and accounts carried out in project management.

**UNIT I PROJECT MANAGEMENT, PROJECT SELECTION AND PROJECT** **9**

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques: PERT,CPM, Government regulations and statutory for various projects.

**UNIT II PROJECT IMPLIMENTATION, MONITORING AND CONTROL** **9**

Project representation: Role of project managers,relevance with objective of organization, preliminary manipulations, Basic Scheduling concepts: Resource levelling, Resource allocation, Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

**UNIT III PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT** **9**

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e–markets in Project Management.

**UNIT IV WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING** **9**

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

**UNIT V FINANCE AND ACCOUNTING 9**

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements, Fixed Assets, Current assets, Depreciation methods :Break even analysis:

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the current market trends to choose projects.

**CO2:** Outline the principles followed in carrying out a project.

**CO3:** Infer the evaluation and auditing related topics in project.

**CO4:** Explain the capital budgeting of the projects.

**CO5:** Relate the finance and accounting of the projects.

**TEXT BOOKS**


1. Project Management Institute, 2017. *A Guide to the Project Management Body of Knowledge*, Sixth Edition, PMBOK Guide.
2. James C.Van Horne, 2004. *Fundamentals of Financial Management*, Person Education.


**REFERENCE BOOKS**


1. Küster J, Huber, E, Lippmann, R, Schmid, A, Schneider, E, Witschi, U, Wüst, R, 2015. *Project Management Handbook*.
2. Khanna, R.B, 2011. *Project Management*, PHI.
3. Prasanna Chandra, 2008. *Financial Management*, Tata McGraw–Hill.
4. By Carl S. Warren, James M. Reeve, Jonathan Duchac. 2016. *Financial & Managerial Accounting*.
5. Paneer Selvam, R, & Senthilkumar, P, 2011. *Project Management*, PHI.

**EC1739 SATELLITE COMMUNICATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the basics of satellite orbits and trajectories.
- To understand the satellite and earth segment.
- To understand the basic principles of satellite link design.
- To analyze the various methods of satellite access.
- To understand the applications of satellites.

**UNIT I SATELLITE ORBITS AND TRAJECTORIES 9**

Kepler's Laws, Newton's law,orbital parameters, orbital perturbations, station keeping, Look Angle determination – Limits of visibility - eclipse - Sub satellite point – Sun transit outage – Launching Procedures – Launch vehicles and propulsion.

**UNIT II SPACE SEGMENT 9**

Spacecraft Technology – Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command – Transponders - The Antenna Subsystem.

**UNIT III SATELLITE LINK DESIGN 9**

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

**UNIT IV MULTIPLE ACCESS FOR SATELLITE COMMUNICATIONS 9**

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: TDMA, FDMA, CDMA, SDMA, DAMA Assignment Methods.

**UNIT V SATELLITE APPLICATIONS 9**

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Direct Broadcast satellites (DBS/DTH), 5G Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the Satellite Orbits in space and relate the different spacecraft launching procedure.

**CO2:** Outline the spacecraft technologies along with various subsystems.

**CO3:** Explain the design of link analysis for satellite systems.

**CO4:** Compare the different multiple access schemes for satellite communication.

**CO5:** Summarize the various applications of satellite.

**TEXT BOOKS**


1. Roddy, D, 2006. *Satellite communications*. McGraw–Hill Education.
2. Timothy, Pratt, Charles, W.Bostain, Jeremy E.Allnutt, 2002. *Satellite Communication*, 2nd Edition, Wiley Publications.


**REFERENCE BOOKS**


1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson 2007. *Satellite Communication Systems Engineering*, Prentice Hall/Pearson.
2. N.Agarwal 1986. *Design of Geosynchronous Space Craft*, Prentice Hall.
3. Bruce R. Elbert 1997. *The Satellite Communication Applications*, Hand Book, Artech House Bostan London.
4. Tri T. Ha 1990. *Digital Satellite Communication*, II edition, McGraw–Hill.
5. Emanuel Fthenakis 1984. *Manual of Satellite Communications*, McGraw Hill Book Co.
6. Robert G. Winch 1983. *Telecommunication Trans Mission Systems*, McGraw–Hill Book Co.
7. Brian Ackroyd 1990. *World Satellite Communication and earth station Design*, BSP Professional Books.
8. G.B.Bleazard 1985. *Introducing Satellite communications*, NCC Publication.
9. M.Richharia 2003. *Satellite Communication Systems – Design Principles*, Macmillan.

**EC1740 SOFT COMPUTING AND OPTIMIZATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To study the various soft computing frame works.
- To be familiar with the design of neural networks.
- To understand the concepts of fuzzy logic and fuzzy systems.
- To learn mathematical background for optimized genetic programming.
- To expose to optimization techniques.

**UNIT I INTRODUCTION TO SOFT COMPUTING 9**

Introduction - Artificial Intelligence - Artificial Neural Networks - Fuzzy Systems - Genetic Algorithm and Evolutionary Programming - Swarm Intelligent Systems - Classification of ANNs - McCulloch and Pitts Neuron Model - Learning Rules: Hebbian and Delta - Perceptron Network - Adaline Network - Madaline Network.

**UNIT II ARITIFICAL NEURAL NETWORKS 9**

Back propagation Neural Networks – Kohonen Neural Network - Learning Vector Quantization - Hamming Neural Network – Hopfield Neural Network - Bi–directional Associative Memory - Adaptive Resonance Theory Neural Networks - Support Vector Machines - Spike Neuron Models.

**UNIT III FUZZY SYSTEMS 9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions - Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

**UNIT IV GENETIC ALGORITHMS 9**

Basic Concepts - Working Principles - Encoding - Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion - Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.

**UNIT V OPTIMIZATION TECHNIQUES 9**

Introduction, Numerical methods of optimization, Genetic Algorithm, Memetic Algorithms, Bio Inspired optimization algorithms - Particle Swarm Optimization, Ant Colony Optimization, Grey Wolf Optimization (GWO) algorithm.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain Soft Computing techniques and classify the various soft computing frame works.

**CO2:** Make use of Neural Network architecture to design different learning networks and its application.

**CO3:** Utilize Fuzzy logic to study and analysis the various fuzzy rules and its application.

**CO4:** Choose the concepts of Genetic Algorithm and Optimization Techniques for different real life problems.

**CO5:** Explain the basic concepts of different optimization techniques.

**TEXT BOOKS**


1. Jhy– Shing Roger Jang, Chuen Tsai Sun, 2002. *Neuro–Fuzzy and Soft Computing*, PHI / Pearson Education.
2. S.N.Sivanandam & S.N.Deepa, 2011. *Principles of Soft Computing*, Wiley India Pvt Ltd.


**REFERENCE BOOKS**


1. Kaushik Kumar, Supriyo Roy, J. Paulo Davim, 2019. *Soft Computing Techniques for Engineering Optimization*, CRC Press.
2. Kwang H. Lee, 2005. *First Course on Fuzzy Theory and Applications,* Springer.
3. S.Rajasekaran & G.A.Vijayalakshmi Pai, 2006. *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications*, Prentice–Hall of India Pvt. Ltd.
4. George J. Klir, Ute St. Clair, Bo Yuan, 1996. *Fuzzy Set Theory: Foundations and Applications*, Prentice Hall.
5. David E. Goldberg, 2013. *Genetic Algorithm in Search Optimization and Machine Learning*, Pearson Education India.
6. James A. Freeman, David M. Skapura, 2003. *Neural Networks Algorithms, Applications, and Programming Techniques*, Pearson Education India.
7. Simon Haykin, 2005. *Neural Networks Comprehensive Foundation* Second Edition, Pearson Education.

**EC1741** **VIDEO ANALYTICS**

| L | T | P | C |
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**OBJECTIVES:**

- To understand the need for video Analytics.
- To study the video analytic components and foreground extraction.
- To learn the basic configuration of video analytics.
- To be familiar with the functional blocks of a video analytic system.
- To get exposed to the various applications of video analytics.

**UNIT I VIDEO ANALYTIC COMPONENTS 9**

Need for Video Analytics - Overview of video Analytics - Foreground extraction - Feature extraction - classifier - Preprocessing - edge detection - smoothening - Feature space - PCA - FLD – SIFT features.

**UNIT II FOREGROUND EXTRACTION 9**

Background estimation - Averaging - Gaussian Mixture Model - Optical Flow based - Image Segmentation - Region growing - Region splitting - Morphological operations - erosion - Dilation - Tracking in a multiple camera environment.

**UNIT III CLASSIFIERS 9**

Neural networks (back propagation) - Deep learning networks - Fuzzy Classifier - Bayesian classifier – HMM based classifier.

**UNIT IV VIDEO ANALYTICS FOR SECURITY 9**

Abandoned object detection - human behavioral analysis - human action recognition - perimeter security - crowd analysis and prediction of crowd congestion.

**UNIT V VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE & TRAFFIC MONITIRING AND ASSISTANCE 9**

Customer behavior analysis – people counting – Traffic rule violation detection – traffic congestion identification for route planning – driver assistance – lane change warning.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the need of video analytics.

**CO2:** Outline Video analytic Component and foreground extraction.

**CO3:** Infer video analytic algorithms for security applications.

**CO4:** Explain video analytic algorithms for business intelligence.

**CO5:** Design custom made video analytics system for the given target application.

**TEXT BOOKS**


1. Jones, G.A. and Paragios, N, 2002. *Video–based surveillance systems: computer vision and distributed processing.*
2. Dey, N, Ashour, A. and Acharjee, S. eds, 2016. *Applied video processing in surveillance and monitoring systems*. IGI Global.


**REFERENCE BOOKS**


1. Chen, Z. Yang, Y. Xue, J. Ye, L. and Guo, F, 2014. *The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite*, Create Space Independent Publishing Platform.
2. Shan, C. Porikli, F. Xiang, T. and Gong, 2012. *Video Analytics for Business Intelligence, Studies in Computational Intelligence*, Springer.

**EI1738** **ROBOTICS AND AUTOMATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart knowledge on the basic concepts associated with the design, functioning, applications and social aspects of robots.
- To provide the concept of electrical drive systems and sensors used in robotics for various applications.
- To make the students learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end–effector.
- To educate about various motion planning techniques and the associated control architecture.
- To make the students explore the implications of AI and other trending concepts of robotics.

**UNIT I FOUNDATION FOR BEGINNERS 9**

Introduction - brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation - ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator.

**UNIT II BUILDING BLOCKS OF A ROBOT 9**

Types of electric motors - DC Servo, Stepper; specification, drives for motors – speed & direction control and circuitry, Selection criterion for actuators, direct drives, non–traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments - optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self-driving cars.

**UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END–EFFECTORS 9**

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D–H representation, kinematics of WMR, Lagrangian formulation

for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End–effector – common types and design case study.

**UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE** **9**

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

**UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS** **9**

Application of Machine learning - AI, Expert systems; Tele–robotics and Virtual Reality, Micro & Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation.

**CO2:** Examine different sensors and actuators for applications like maze solving and self–driving cars.

**CO3:** Analyze robot kinematics, dynamics through different methodologies.

**CO4:** Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.

**CO5:** Describe the impact and progress in AI and other research trends in the field of robotics.

**TEXT BOOKS**

1. Saeed. B. Niku, 2002. *Introduction to Robotics, Analysis, system, Applications*, Pearson Educations.
2. Roland Siegwart, Illah Reza Nourbakhsh, 2011. *Introduction to Autonomous Mobile Robots*, MIT Press.

**REFERENCE BOOKS**


1. Richard David Klafter, Thomas A. Chmielewski, and Michael Negin, 1989. *Robotic engineering: an integrated approach*, Prentice Hall.
2. Craig, J. J,1989. *Introduction to Robotics: Mechanics and Control*, Addison–Wesley, 2nd Edition.
3. Fu,K.C, Gonzalez,R.C, and Lee, C.S.G,1987. *Robotics: Control, Sensing, Vision and Intelligence*, McGraw–Hill.
4. Wesley, E and Snyder R,1988. *Industrial Robots, Computer Interfacing and Control*, Prentice Hall International Edition.
5. Robin Murphy, 2000. *Introduction to AI Robotics*, MIT Press.

**OEC171** **BIOMEDICAL ELECTRONICS**

| L | T | P | C |
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**OBJECTIVES:**

- To gain knowledge about the various physiological parameters both electrical and non electrical.
- To gain knowledge about the methods of recording and also the method of transmitting these parameters.
- To study about the various assist devices used in the hospitals.
- To gain knowledge about equipment used for physical medicine.
- To gain knowledge about the various recently developed diagnostic and therapeutic techniques.

**UNIT I** **ELECTRO–PHYSIOLOGY AND BIO–POTENTIAL RECORDING** **9**

Sources of biomedical signals, Bio–potentials, Bio-potential electrodes, biological amplifiers, Typical waveforms and signal characteristics - ECG, EEG, EMG, PCG.

**UNIT II** **BIO–CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT** **9**

PH, $PO_2$, $PCO_2$, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

**UNIT III** **ASSIST DEVICES** **9**

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

**UNIT IV** **PHYSICAL MEDICINE AND BIOTELEMETRY** **9**

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Bio-telemetry and applications.

**UNIT V** **RECENT TRENDS IN MEDICAL INSTRUMENTATION** **9**

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the human body electro-physiological parameters and recording of bio-potentials.

**CO2:** Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

**CO3:** Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.

**CO4:** Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio–telemetry principles and methods.

**CO5:** Describe about recent trends in medical instrumentation.

**TEXT BOOKS**

1. Leislie Cromwell, 2007. *Biomedical Instrumentation and Measurement*, Prentice Hall of India, New Delhi.
2. Khandpur, R.S, 2003. *Handbook of Biomedical Instrumentation*, TATA McGraw–Hill, New Delhi.

**REFERENCE BOOKS**

1. Joseph J.Carr and John M.Brown, 2004. *Introduction to Biomedical Equipment Technology*, John Wiley and Sons, New York.

**OEC172 COMPUTER COMMUNICATION NETWORKS**

| L | T | P | C |
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**OBJECTIVES:**

- To discuss the fundamental concepts of computer networking.
- To understand the various data link layer issues.
- To implement the routing algorithms to identify routes in a given network.
- To discuss the concepts of transport layer protocols.
- To describe some real network applications.

**UNIT I NETWORK FUNDAMENTALS 9**

Overview of Data Communications, Network & its types, Performance, Networks models - Protocol Layering, TCP / IP protocol suite, TCP / IP protocol suite, Layers in OSI model, Switching Network - Circuit, Packet & Message.

**UNIT II DATA LINK LAYER 9**

Introduction to Data Link Layer, Link layer Addressing - ARP,Error Detection & Correction, Framing, Media access control, Wired LANs: Ethernet 802.3, Wireless LAN, Bluetooth and Virtual LANs.

**UNIT III NETWORK LAYER 9**

Network Layer Services, Logical addressing : IPv4, Network Layer Protocols - IP, ICMP, Basic Internetworking - DHCP, Unicast Routing, Multicast Address & routing - DVMRP, PIM, Overview of Intradomain and Interdomain Protocols, IPV6 Address, Transition from IPV4 to IPV6.

**UNIT IV TRANSPORT LAYER 9**

Introduction to Transport layer, Protocols - UDP, TCP - Services - Features, TCP connection - State Transition Diagram, Flow, Error and Congestion control, Congestion avoidance - DEC bit& RED, QoS - Application requirements.

**UNIT V APPLICATION LAYER 9**

Application Layer Paradigms - Client Server Programming, WWW - HTTP, Electronic Mail - SMTP, POP3, IMAP, MIME, DNS, Need for Network Security, Cryptography - Symmetric key and public key algorithms, Firewalls.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the various protocols used in each layers of the network architecture.

**CO2:** Examine the protocol performance used for different purposes like error control, flow control, logical addressing.

**CO3:** Apply the standard routing algorithms to identify routes in a given network.

**CO4:** Explain the concepts of transport layer protocols.

**CO5:** Classify the protocols for developing various applications in application layer.

**TEXT BOOKS**


1. Behrouz A. Forouzan, 2013. *Data communication and Networking*: Fifth Edition, Tata McGraw – Hill
2. Kurose, J.F, 2005. *Computer networking: A top–down approach featuring the internet*, 3/E. Pearson Education India.


**REFERENCE BOOKS**


1. Mir, N.F, 2015. *Computer and Communication Networks*. Pearson Education.
2. Lin, Y.D, Baker, F. and Hwang, R.H, 2011. *Computer Networks: An Open Source Approach*. McGraw Hill.
3. Basagni, S. and Choi, Y, 2011. *In Praise of Computer Networks: A Systems Approach*, Fifth Edition.

**OEC173 ELECTRONIC PACKAGING AND TESTING**

| L | T | P | C |
|---|---|---|---|
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**OBJECTIVES:**

- To study the overview of Electronic systems packages.
- To discuss the various electrical issues in packages.
- To understand the chip packages.
- To understand the design of PCBs and operate at higher frequency.
- To study the concepts of testing for packages.

**UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9**

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

**UNIT II ELECTRICAL ISSUES IN PACKAGING 9**

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitics.

**UNIT III CHIP PACKAGES 9**

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded.

**UNIT IV PCB, SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS 9**

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements.

**UNIT V TESTING 9**

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue - failures - thermo mechanically induced - electrically induced - chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the overview of Electronic system packages.

**CO2:** Explain the various electrical issues in packages.

**CO3:** Compare the various types of chip packaging.

**CO4:** Design of PCBs which minimize the EMI and operate at higher frequency.

**CO5:** Compare the various methods of testing for packages.

**TEXT BOOKS**


1. Tummala, R.R, 2001. *Fundamentals of Microsystems Packaging*. McGraw–Hill Education.
2. Blackwell, G.R, 2000. Design for Test. In *The Electronic Packaging Handbook*. CRC Press LLC.


**REFERENCE BOOKS**


1. Bosshart, W.C, Shah, A. and Bhat, S.R, 1983. *Printed circuit boards: design and technology*. Tata McGraw–Hill.
2. Khandpur, R.S, 2006. *Printed circuit boards: design, fabrication, assembly and testing*. Tata McGraw–Hill Education.
3. Bushnell, M. and Agrawal, V, 2004. *Essentials of electronic testing for digital, memory and mixed–signal VLSI circuits* (Vol. 17). Springer Science & Business Media.
4. Abramovici, M, Breuer, M.A. and Friedman, A.D, 1990. *Digital systems testing and testable design* (Vol. 2, pp. 203–208). New York: Computer science press.

**OEC174** **MEMS, NEMS AND BIO–MEMS**

| L | T | P | C |
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**OBJECTIVES:**

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors.
- To introduce the concepts of quantum mechanics and nano systems.
- To provide basic educational foundation in micro–systems engineering emphasizing Biomedical micro–devices.

**UNIT I INTRODUCTION TO MEMS AND NEMS 9**

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

**UNIT II MEMS FABRICATION TECHNOLOGIES 9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

**UNIT III MICRO SENSORS 9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester.

**UNIT IV NANO DEVICES 9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnOnano rods based NEMS device: Gas sensor.

**UNIT V MICROFLUIDIC DEVICES AND COMPONENTS FOR BIO–MEMS 9**

Micropump and microneedles applications in Bio–MEMS, Micromixers, Microfabricated Devices for Sample Extraction, Concentrations and Related Sample Processing Technologies, Bio–MEMS Devices in Cell Manipulation: Microflow Cytometry and applications.

**TOTAL: 45 PERIODS**

## OUTCOMES

**CO1:** Summarize the Concept of miniaturization, need for MEMS in various applications and also the need for packaging.

**CO2:** Interpret the various Micro fabrication techniques involved in MEMS design.

**CO3:** Design and analyze RF MEMS components such as switches, Capacitors, phase shifters and antennas.

**CO4:** Explain about various nano devices.

**CO5:** Explain about microfluidic devices for drug delivery systems.

## TEXT BOOKS


1. Varadan, V.K, Vinoy, K.J. and Jose, K.A, 2003. *RF MEMS and their applications*. John Wiley & Sons.
2. Madou, M.J, 2018. *Fundamentals of microfabrication: the science of miniaturization*. CRC press.


## REFERENCE BOOKS


1. Hsu, T.R,2002. *MEMS and Microsystems: Design and Manufacture, McGraw Hill*.
2. Wang, W. and Soper, S.A. eds, 2007. *Bio–MEMS: technologies and applications*. CRC press.
3. Liu, C, 2012. *Foundations of MEMS*. Pearson Education India.
4. Lyshevski, S.E, 2018. *MEMS and NEMS: systems, devices, and structures*. CRC press.
5. Madou, M.J, 2018. *Fundamentals of microfabrication: the science of miniaturization*. CRC press.

**OEC175 SEMICONDUCTOR DEVICES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To analyze simple diode Circuits.
- To introduce BJT basic operation, characteristics and application.
- To acquaint with the construction, theory and operation of Field Effect Transistors.
- To interpret the Special Semiconductor Diodes, Power Devices and Display Devices.
- To apply the concepts of DC power supplies.

**UNIT I SEMICONDUCTOR DIODES 9**

PN junction Diodes - Formation of PN junction, working principle, VI characteristics - diode resistance - PN diode currents - diode current equation - transition and diffusion capacitance - voltage breakdown in diodes.

**UNIT II BIPOLAR JUNCTION TRANSISTORS 9**

Principle and Operation of PNP, NPN transistors, Early effect, Current Equation, BJT as a switch and Amplifier, Breakdown Mechanisms of Transistors - Input and Output Characteristics of CE, CB, CC.

**UNIT III FIELD EFFECT TRANSISTORS 9**

Principle and Operation of N channel and P channel JFET, Drain and Transfer Characteristics, Current Equation, Pinch off Voltage and its significance, Breakdown mechanisms of JFET.MOSFET - Characteristics, Threshold voltage, Channel Length Modulation, MOSFET Capacitor, D–MOSFET - E–MOSFET Characteristics - Comparison of MOSFET with JFET.

**UNIT IV SPECIAL SEMICONDUCTOR DIODES 9**

Zener Diode - Varactor diode - Tunnel diode - Schottky diode - LED - Photo Diode - LCD, LDR, Opto Coupler, Solar Cell.

**UNIT V DC POWER SUPPLIES 9**

HWR, FWR, full–wave bridge rectifier, power supply filters - ripple factor, efficiency analysis - bleeder resistor. Voltage regulation - Design of DC power supply circuit.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the working principle of PN junction diode and its characteristics.

**CO2:** Outline the working principle of BJT, various configuration and its characteristics.

**CO3:** Illustrate the working principle of FET to find equivalent circuits and its parameters.

**CO4:** Interpret the special semiconductor diodes and display devices. Explain the linear mode power supply and voltage regulators.

**CO5:** Classify the protocols for developing various applications in application layer.

**TEXT BOOKS**


1. Thomas L. Floyd, 2012. *Electronic Devices*, 9th edition, Pearson Education.
2. Donald A Neaman, 2012. *Semiconductor Physics and Devices*, 4th Edition, Tata McGraw Hill.


**REFERENCE BOOKS**


1. R.S.Sedha, 2006. *A Text Book of Applied Electronics*, S.Chand Publications.
2. Ben. G. Streetman & Sanjay Kumar Banerjee, 2015. *Solid State Electronic Devices*, 7th Edition, Pearson Education India.
3. Robert Boylestad & Louis Nashelsky, 2008. *Electron Devices and Circuit Theory,* Pearson Prentice Hall, 10th edition.
4. Yang, 1978. *Fundamentals of Semiconductor devices*, McGraw Hill International Edition.
5. Adel S. Sedra & Kenneth C. Smith, 2017. *Microelectronic Circuits: Theory and Applications*, 7th Edition, Oxford University Press.

| OEC176 | TELECOMMUNICATION SYSTEM MODELING AND SIMULATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn the use of random process concepts in telecommunication system simulation.
- To gain knowledge in modeling of different communication systems.
- To know the techniques involved in performance estimation of telecommunication systems.
- To study the modeling methodologies of a telecommunication system.
- To study about the digital communication radio link environment.

**UNIT I SIMULATION OF RANDOM VARIABLES RANDOM PROCESS** **9**

Generation of random numbers and sequence - Gaussian and uniform random numbers Correlated random sequences - Testing of random numbers generators - Stationary and uncorrelated noise - Goodness of fit test.

**UNIT II MODELING OF COMMUNICATION SYSTEMS** **9**

Radio frequency and optical sources – Analog and Digital signals – Communication channel and model - Free space channels – Multipath channel and discrete channel noise and interference.

**UNIT III ESTIMATION OF PERFORMANCE MEASURE FOR SIMULATION** **9**

Quality of estimator - Estimation of SNR - Probability density function and bit error rate - Monte Carlo method - Importance sampling method - Extreme value theory.

**UNIT IV SIMULATION AND MODELING METHODOLOGY** **9**

Simulation environment - Modeling considerations - Performance evaluation techniques - Error source simulation - Validation.

**UNIT V CASE STUDIES** **9**

Simulations of QAM digital radio link environment - Light wave communication link - Satellite system.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Solve the constituents of a telecommunication system.

**CO2:** Classify the various modeling methodologies and simulation techniques.

**CO3:** Show the performance measures of telecommunication systems.

**CO4:** Choose the system modeling methodology in telecommunication.

**CO5:** Explain the digital communication radio link environment in light wave and satellite system.

**TEXT BOOKS**


1. Jeruchim MC Balaban P Sam K Shanmugam, 2002. *Simulation of communication Systems: Modeling, Methodology and Techniques*, Plenum press, New York.
2. Jerry banks & John S Carson, 1996. *Discrete Event System Simulation*, PHI.


**REFERENCE BOOKS**


1. Averill M Law, 2007. *Simulation Modeling and Analysis*, McGraw–Hill Inc.
2. Geoffrey Gorden, 1992. *System Simulation*, Prentice Hall of India.
3. Turin W, 1990. *Performance Analysis of Digital Communication Systems*, Computer Science Press, New York.