

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
IV YEAR COURSE STRUCTURE & SYLLABUS (R16)****Applicable From 2016-17 Admitted Batch****IV YEAR I SEMESTER**

| S.No. | Course Code | Course Title                   | L         | T        | P         | Credits   |
|-------|-------------|--------------------------------|-----------|----------|-----------|-----------|
| 1     | EC701PC     | Microwave Engineering          | 4         | 0        | 0         | 4         |
| 2     |             | Professional Elective - II     | 3         | 0        | 0         | 3         |
| 3     |             | Professional Elective - III    | 3         | 0        | 0         | 3         |
| 4     |             | Professional Elective - IV     | 3         | 0        | 0         | 3         |
| 5     | EC702PC     | VLSI Design                    | 4         | 0        | 0         | 4         |
| 6     | EC703PC     | VLSI and E-CAD Lab             | 0         | 0        | 3         | 2         |
| 7     | EC704PC     | Microwave Engineering Lab      | 0         | 0        | 3         | 2         |
| 8     | EC705PC     | Industry Oriented Mini Project | 0         | 0        | 3         | 2         |
| 9     | EC706PC     | Seminar                        | 0         | 0        | 2         | 1         |
|       |             | <b>Total Credits</b>           | <b>17</b> | <b>0</b> | <b>11</b> | <b>24</b> |

**IV YEAR II SEMESTER**

| S.No. | Course Code | Course Title              | L        | T        | P         | Credits   |
|-------|-------------|---------------------------|----------|----------|-----------|-----------|
| 1     |             | Open Elective – III       | 3        | 0        | 0         | 3         |
| 2     |             | Professional Elective -V  | 3        | 0        | 0         | 3         |
| 3     |             | Professional Elective -VI | 3        | 0        | 0         | 3         |
| 4     | EC801PC     | Major Project             | 0        | 0        | 30        | 15        |
|       |             | <b>Total Credits</b>      | <b>9</b> | <b>0</b> | <b>30</b> | <b>24</b> |

**Professional Elective – I**

|         |                                            |
|---------|--------------------------------------------|
| EC611PE | Computer organization and operating system |
| EC612PE | Digital Image Processing                   |
| EC613PE | Spread Spectrum Communications             |
| EC614PE | Digital system Design                      |

**Professional Elective – II**

|         |                                                  |
|---------|--------------------------------------------------|
| EC721PE | Computer Networks                                |
| EC722PE | Telecommunication Switching Systems and Networks |
| EC723PE | RF Circuit Design                                |
| EC724PE | Artificial Neural Networks                       |

**Professional Elective – III**

|         |                                              |
|---------|----------------------------------------------|
| EC731PE | Cellular and Mobile Communications           |
| EC732PE | Electronics Measurements and Instrumentation |
| EC733PE | EMI and EMC                                  |
| EC734PE | Object Oriented Programming through JAVA     |

**Professional Elective – IV**

|         |                                   |
|---------|-----------------------------------|
| EC741PE | Optimization Techniques           |
| EC742PE | Embedded System Design            |
| EC743PE | Satellite Communications          |
| EC744PE | Network Security and Cryptography |

**Professional Elective – V**

|         |                                      |
|---------|--------------------------------------|
| EC851PE | Optical Communications               |
| EC852PE | Wireless Communications and Networks |
| EC853PE | Design of Fault Tolerant Systems     |
| EC854PE | Bio Medical Instrumentation          |

**Professional Elective –VI**

|         |                              |
|---------|------------------------------|
| EC861PE | Radar Systems                |
| EC862PE | Coding Theory and Techniques |
| EC863PE | Database Management Systems  |
| EC864PE | Global Positioning System    |

**\*Open Elective** subjects' syllabus is provided in a separate document.

**\*Open Elective** – Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

**Ex:** - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR**  
**B.TECH. III AND IV YEARS**

| <b>S. No.</b> | <b>Name of the Department Offering Open Electives</b>                  | <b>Open Elective – I (Semester – V)</b>                                                                            | <b>Open Elective – II (Semester – VI)</b>                                                                                                |
|---------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | Aeronautical Engg.                                                     | AE511OE: Introduction to Space Technology                                                                          | AE621OE: Introduction to Aerospace Engineering                                                                                           |
| 2             | Automobile Engg.                                                       | CE511OE: Disaster Management<br>MT512OE: Intellectual Property Rights                                              | MT621OE: Data Structures<br>MT622OE: Artificial Neural Networks                                                                          |
| 3             | Biomedical Engg.                                                       | BM511OE: Reliability Engineering                                                                                   | BM621OE: Medical Electronics                                                                                                             |
| 4             | Civil Engg.                                                            | CE511OE: Disaster Management.                                                                                      | CE621OE: Remote Sensing and GIS<br>CE622OE: Geo-Informatics<br>CE623OE: Intellectual Property Rights                                     |
| 5             | Civil and Environmental Engg.                                          | CE511OE: Disaster Management                                                                                       | CN621OE: Environmental Impact Assessment<br>CE623OE: Intellectual Property Rights                                                        |
| 6             | Computer Science and Engg. / Information Technology                    | CS511OE: Operating Systems<br>CS512OE: Database Management Systems                                                 | CS621OE: Java Programming<br>CS622OE: Software Testing Methodologies<br>CS623OE: Cyber Security                                          |
| 7             | Electronics and Communication Engg. / Electronics and Telematics Engg. | EC511OE: Principles of Electronic Communications                                                                   | EC621OE: Principles of Computer Communications and Networks                                                                              |
| 8             | Electronics and Computer Engg.                                         | EM511OE: Scripting Languages                                                                                       | EM621OE: Soft Computing Techniques                                                                                                       |
| 9             | Electrical and Electronics Engg.                                       | EE511OE: Non-Conventional Power Generation<br>EE512OE: Electrical Engineering Materials<br>EE513OE: Nanotechnology | EE621OE: Design Estimation and Costing of Electrical Systems<br>EE622OE: Energy Storage Systems<br>EE623OE: Introduction to Mechatronics |
| 10            | Electronics and Instrumentation Engg.                                  | EI511OE: Electronic Measurements and Instrumentation                                                               | EI621OE: Industrial Electronics                                                                                                          |
| 11            | Mechanical Engg.                                                       | ME511OE: Optimization Techniques<br>ME512OE: Computer Graphics<br>ME513OE: Introduction                            | ME621OE: World Class Manufacturing<br>ME622OE: Fundamentals of Robotics<br>ME623OE: Fabrication                                          |

|    |                                                        |                                                                                                                              |                                                                                                                                             |
|----|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                        | to Mechatronics<br>ME514OE:<br>Fundamentals of<br>Mechanical Engineering                                                     | Processes                                                                                                                                   |
| 12 | Mechanical Engg. (Material Science and Nanotechnology) | NT511OE: Fabrication Processes<br>NT512OE: Non destructive Testing Methods<br>NT513OE: Fundamentals of Engineering Materials | NT621OE: Introduction to Material Handling<br>NT622OE: Non-Conventional Energy Sources<br>NT623OE: Robotics                                 |
| 13 | Mechanical Engg. (mechatronics)                        | MT511OE: Analog and Digital I.C. Applications<br>MT512OE: Intellectual Property Rights<br>MT513OE: Computer Organization     | MT621OE: Data Structures<br>MT622OE: Artificial Neural Networks<br>MT623OE: Industrial Management                                           |
| 14 | Metallurgical and Materials Engg.                      | MM511OE: Materials Characterization Techniques                                                                               | MM621OE: Science and Technology of Nano Materials<br>MM622OE: Metallurgy of Non Metallurgists                                               |
| 15 | Mining Engg.                                           | MN511OE: Introduction to Mining Technology                                                                                   | MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas                                                                                  |
| 16 | Petroleum Engg.                                        | PE511OE: Materials Science and Engineering<br>PE512OE: Renewable Energy Sources<br>PE513OE: Environmental Engineering        | PE621OE: Energy Management and Conservation<br>PE622OE: Optimization Techniques<br>PE623OE: Entrepreneurship and Small Business Enterprises |

| S. No. | Name of the Department Offering Open Electives | Open Elective –III (Semester – VIII)                                                                                                                    |
|--------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Aeronautical Engg.                             | AE831OE: Air Transportation Systems<br>AE832OE: Rockets and Missiles                                                                                    |
| 2      | Automobile Engg.                               | AM831OE: Introduction to Mechatronics<br>AM832OE: Microprocessors and Microcontrollers                                                                  |
| 3      | Biomedical Engg.                               | BM831OE: Telemetry and Telecontrol<br>BM832OE: Electromagnetic Interference and Compatibility                                                           |
| 4      | Civil Engg.                                    | CE831OE: Environmental Impact Assessment<br>CE832OE: Optimization Techniques in Engineering<br>CE833OE: Entrepreneurship and Small Business Enterprises |
| 5      | Civil and Environmental Engg.                  | CN831OE: Remote Sensing and GIS<br>CE833OE: Entrepreneurship and Small Business                                                                         |

|    |                                                                        |                                                                                                                                                                                 |
|----|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                        | Enterprises                                                                                                                                                                     |
| 6  | Computer Science and Engg. / Information Technology                    | CS831OE: Linux Programming<br>CS832OE: R Programming<br>CS833OE: PHP Programming                                                                                                |
| 7  | Electronics and Communication Engg. / Electronics and Telematics Engg. | EC831OE: Electronic Measuring Instruments                                                                                                                                       |
| 8  | Electronics and Computer Engg.                                         | EM831OE: Data Analytics                                                                                                                                                         |
| 9  | Electrical and Electronics Engg.                                       | EE831OE: Entrepreneur Resource Planning<br>EE832OE: Management Information Systems<br>EE833OE: Organizational Behaviour                                                         |
| 10 | Electronics and Instrumentation Engg.                                  | EI831OE: Sensors and Transducers,<br>EI832OE: PC Based Instrumentation                                                                                                          |
| 11 | Mechanical Engg.                                                       | ME831OE: Total Quality Management<br>ME832OE: Industrial Safety, Health, and Environmental Engineering<br>ME833OE: Basics of Thermodynamics<br>ME834OE: Reliability Engineering |
| 12 | Mechanical Engg. (Material Science and Nanotechnology)                 | NT831OE: Concepts of Nano Science And Technology<br>NT832OE: Synthesis of Nanomaterials<br>NT833OE: Characterization of Nanomaterials                                           |
| 13 | Mechanical Engg. (mechatronics)                                        | MT831OE: Renewable Energy Sources<br>MT832OE: Production Planning and Control<br>CE833OE: Entrepreneurship and Small Business Enterprises                                       |
| 14 | Metallurgical and Materials Engg.                                      | MM831OE: Design and Selection of Engineering Materials                                                                                                                          |
| 15 | Mining Engg.                                                           | MN831OE: Solid Fuel Technology<br>MN832OE: Health & Safety in Mines                                                                                                             |
| 16 | Petroleum Engg.                                                        | PE831OE: Disaster Management<br>PE832OE: Fundamentals of Liquefied Natural Gas<br>PE833OE: Health, Safety and Environment in Petroleum Industry                                 |

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**MICROWAVE ENGINEERING**

**B.Tech. IV Year I Sem.**  
**Course Code: EC701PC**

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**Course Objectives:** This is a core course in Microwave Communications domain, and covers contents related to Microwave Theory and Techniques. The main objectives of the course are:

- To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
- To develop the theory related to microwave transmission lines, and to determine the characteristics of rectangular waveguides, microstrip lines, and different types of waveguide components and ferrite devices.
- To distinguish between different types of microwave tubes, their structures and principles of microwave power generation, and to characterize their performance features and applications - at tube levels as well as with solid state devices.
- To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
- To understand the concepts of microwave measurements, identify the equipment required and precautions to be taken, and get familiarized with the methods of measurement of microwave power and various other microwave parameters.

**Course Outcomes:** Having gone through this course covering different aspects of microwave theory and techniques, the students would be able to

- To analyze completely the rectangular waveguides, their mode characteristics, and design waveguides for solving practical microwave transmission line problems.
- To distinguish between the different types of waveguide and ferrite components, explain their functioning and select proper components for engineering applications.
- To distinguish between the methods of power generation at microwave frequencies, derive the performance characteristics of 2-Cavity and Reflex Klystrons, Magnetrons, TWTs and estimate their efficiency levels, and solve related numerical problems
- To realize the need for solid state microwave sources, understand the concepts of TEDs, RWH Theory and explain the salient features of Gunn Diodes and ATT Devices.
- To establish the properties of Scattering Matrix, formulate the S-Matrix for various microwave junctions, and understand the utility of S-parameters in microwave component design.

- To set up a microwave bench, establish the measurement procedure and conduct the experiments in microwave lab for measurement of various microwave parameters.

### UNIT - I

**Microwave Transmission Lines - I:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – Solution of Wave Equations in Rectangular Coordinates, TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations, Power Transmission, Impossibility of TEM Mode. Illustrative Problems, Micro strip Lines– Introduction,  $Z_0$  Relations, Effective Dielectric Constant.

### UNIT - II

**Cavity Resonators**– Introduction, Rectangular Cavities, Dominant Modes and Resonant Frequencies, Q Factor and Coupling Coefficients, Illustrative Problems

**Waveguide Components and Applications:** Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee. Directional Couplers – 2 Hole, Bethe Hole types, Illustrative Problems

Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrotator, Isolator, Circulator.

### UNIT - III

**Microwave Tubes:** Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics, Illustrative Problems.

**Helix TWTs:** Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

### UNIT - IV

#### **M-Type Tubes:**

Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics, Illustrative Problems

**Microwave Solid State Devices:** Introduction, Classification, Applications. TEDs – Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Introduction to Avalanche Transit Time Devices.

**UNIT - V**

Scattering Matrix– Significance, Formulation and Properties, S Matrix Calculations for – 2 port Junctions, E plane and H plane Tees, Magic Tee, Circulator and Isolator, Illustrative Problems.

**Microwave Measurements:** Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Microwave Power Measurement, Bolometers. Measurement of Attenuation, Frequency. Standing Wave Measurements – Measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

**TEXT BOOKS:**

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.

**REFERENCES:**

1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
2. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
3. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999.
4. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 Reprint.



**COMPUTER NETWORKS**  
(Professional Elective – II)

**B.Tech. IV Year I Sem.**

**Course Code: ET702PC/EC721PE**

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

**Pre-requisites:** Nil

**Course Objectives:**

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.
- To have the concept of different routing techniques for data communications.

**Course Outcomes:**

- Students should understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and ad hoc networks.

**UNIT - I**

**Introduction to Networks:** Internet, Protocols and Standards, The OSI Model, Layers in OSI Model, TCP/IP Suite, Addressing.

**Physical Layer:** Multiplexing, Transmission Media, Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

**UNIT - II**

**Data Link Layer:** Introduction, Checksum, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, Random Access Controlled Access, Channelization, IEEE Standards, Ethernet, Giga-Bit Ethernet, Wireless LANs, SONET-SDH, Frame Relay and ATM.

**UNIT - III**

**Network Layer:** Logical Addressing, Internetworking, Tunneling, Address Mapping, ICMP, IGMP, Forwarding, Routing-Flooding, Bellman& Ford, Disjkstra's routing protocols, RIP, OSPF, BGP,- and Multicast Routing Protocols. Connecting Devices-Passive Hubs, Repeaters, Active Hubs, Bridges, Routers.

**UNIT - IV**

**Transport Layer:** Process to Process Delivery, UDP, TCP and SCTP Protocols, Congestion, Congestion Control, Quality of Service.

**Application Layer:** Domain Name Space, DNS in Internet, Electronic Mail, File Transfer Protocol, WWW, HTTP, SNMP, Multi-Media.

**UNIT - V**

**Network Security:** Security services, mechanisms and attacks, IPSec, SSL, VPN, Firewall. Bluetooth, Zigbee, IPv4, IPv6.

**TEXT BOOKS:**

1. Data Communications and Networking – Behrouz A. Forouzan, 4<sup>th</sup> Edition Mc Graw Hill Education, 2006.
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3<sup>rd</sup> Edition, Pearson Education.

**REFERENCES:**

1. Data communications and Networks by william stallings
2. Data communication and Networks - Bhusan Trivedi, Oxford university press 2016.
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.
4. Understanding Communications and Networks, 3rd Edition, W.A.Shay, Cengage Learning.

**TELECOMMUNICATION SWITCHING SYSTEMS AND NETWORKS**  
(Professional Elective – II)

**B.Tech. IV Year I Sem.**

**Course Code: ET701PC/EC722PE**

**L T P C**

**3 0 0 3**

**Course Objectives:** The Course is designed

- To provide students with a balanced blend of theoretical and practical aspects regarding Telecommunication Switching System.
- To expose through the evolution of switching systems from manual and Electromechanical systems to stored-program-controlled digital systems
- To provide knowledge to the students regarding design and performance analysis of various switching systems.
- To train the students about basic Telephone Networks structures and traffic engineering concepts
- To inculcate students on various internet concepts like OSI reference model, LAN, WAN, WAN, Repeaters, bridges, routers & gateways.
- To provide a comprehensive coverage of data communication networks and ISDN

**Course outcomes:**

- Students will demonstrate knowledge about Telecommunication Switching Systems.
- Students will be able to analyze different switching methodologies.
- Students will be able to differentiate between signaling methods used in Telecommunication Networks
- Students will exhibit a good knowledge on data communication networks and ISDN and be able to differentiate LAN, MAN, WAN
- Students will demonstrate an ability to work on various Telecommunication Network concepts.
- Students will demonstrate knowledge on modern telecommunication concepts like DSL & SONET.

**UNIT - I**

**Telecommunication Switching Systems:** Introduction, Elements of switching systems, switching network configuration, Rotary switches, Uniselector, Two motion selector, Trunking principle ,principles of cross bar switching, Crossbar Switch Configuration, Cross point Technology, Crossbar Exchange Organization.

**UNIT - II**

**Electronic Space Division Switching:** Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced services, Two-Stage Networks, Three-Stage Networks, n-Stage Networks.

**Time Division Switching:** Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching,

Combination Switching, Three Stage Combination Switching, n - Stage Combinational Switching.

### **UNIT - III**

**Telecommunications Traffic:** Introduction; The Unit of Traffic, Congestion; Traffic Measurement, A Mathematical Model, Lost-Call Systems-Theory, Traffic Performance, Loss Systems in Tandem, Use of Traffic Tables, Queuing Systems-The Second Erlang Distribution, Probability of Delay, Finite Queue Capacity, Some Other Useful Results, Systems with a Single Server, Queues in Tandem, Delay Tables, Applications of Delay Formulae.

### **UNIT - IV**

**Telephone Networks:** Subscriber loop systems, switching hierarchy and routing, transmission plan, transmission systems, numbering plan, charging plan, Signaling techniques: In channel signaling, common channel signaling, Cellular mobile telephony.

**Data Networks:** Data transmission in PSTNs, Switching techniques for data transmission, data communication architecture, link to link layers, end to end layers, satellite based data networks, LAN, MAN, Internetworking.

### **UNIT - V**

**Integrated Services Digital Network (ISDN):** Introduction, motivation, new services, Network and protocol architecture, Transmission channels, User-Network interfaces, functional grouping, reference points, signaling, numbering, addressing, BISDN.

**DSL Technology:** ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS.

**SONET:** Devices, Frame, Frame Transmission, Synchronous Transport Signals, STS I, Virtual Tributaries, and Higher rate of service.

### **TEXT BOOKS:**

1. Tele communication switching system and networks – Thyagarajan Viswanath, PHI, 2000.
2. J. E Flood, “Telecommunications Switching and Traffic Networks,” Pearson Education, 2006
3. Data Communication & Networking - B.A. Forouzan, TMH, 4<sup>th</sup> Edition, 2004.

### **REFERENCES:**

1. Digital telephony - J. Bellamy, John Wiley, 2nd edition, 2001.
2. Data Communications & Networks - Achyut. S. Godbole, TMH, 2004.
3. Principles of Communication Systems – H. Taub & D. Schilling, TMH, 2nd Edition, 2003.
4. An Engineering approach to computer networking - S. Keshav, Addison W

**RF CIRCUIT DESIGN**  
(Professional Elective – II)

**B.Tech. IV Year I Sem.**  
**Course Code: EC723PE**

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

**Course Objectives:** The course objectives are:

- To educate students fundamental RF circuit and system design skills.
- To introduce students the basic transmission line theory, single and multiport networks, RF component modeling.
- To offer students experience on designing matching and biasing networks & RF transistor amplifier design.

**Course Outcomes:** Upon completion of the course, the students will be able to:

- Explore fundamental RF circuit and system design skills.
- Understand the basic transmission line theory, single and multiport networks, RF component modeling.
- Design matching and biasing networks & RF transistor amplifiers.

### UNIT - I

**Introduction:** Importance of RF Design-Dimensions and Units-Frequency Spectrum-RF Behaviour of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors.-Chip Components, and Circuit Board Considerations: Chip Resistors, Chip Capacitors, and Surface Mount Inductors.

**Review of Transmission Lines:** Types of Transmission Lines-Equivalent Circuit representation-R, L, C, G parameters of Different Line configurations-Terminated Lossless Transmission Lines-Special Terminations: Short Circuit, Open Circuit and Quarter Wave Transmission Lines- Sourced and Loaded Transmission Lines: Power Considerations, Input Impedance Matching, Return Loss and Insertion Loss.

### UNIT – II

**Single and Multi-Port Networks:** The Smith Chart: Reflection Coefficient, Normalized Impedance-Impedance Transformation: Standing wave Ratio, Special Transformation Conditions-Admittance Transformation-Parallel and Series RL & RC Connections-Basic Definitions of Single and Multi-Port Networks-Interconnecting Networks.

**RF Filter Design:** Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, Conversion Between S- and Z-parameters, Signal Flow Chart Modeling, Generalization-Basic Resonator and Filter Configurations: Low Pass, High Pass, Band Pass and Band Stop type Filters-Filter Implementation using Unit Element and Kuroda's Identities Transformations-Coupled Filters.

### **UNIT - III**

**Active RF Component Modelling:** RF Diode Models: Nonlinear and Linear Models- Transistor Models: Large Signal and Small Signal BJT Models, Large Signal and Small Signal FET Models- Scattering Parameter, Device Characterization.

### **UNIT - IV**

**Matching and Biasing Networks:** Impedance Matching Using Discrete Components: Two Component Matching Networks, Forbidden Regions, Frequency Response and Quality Factor, T and Pi Matching Networks-Amplifier Classes of Operation and Biasing Networks: Classes of Operation and Efficiency of Amplifiers, Biasing Networks for BJT, Biasing Networks for FET.

### **UNIT – V**

**RF Transistor Amplifier Design:** Characteristics of Amplifiers- Amplifier Power Relations: RF Source, Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, And Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles.

**RF Oscillators and Mixers:** Basic Oscillator Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design steps, Quartz Oscillators- Fixed Frequency High Frequency Oscillator -Basic Characteristics of Mixers: Concepts, Frequency Domain Considerations, Single Ended Mixer Design, Single, and Double Balanced Mixers.

### **TEXT BOOKS:**

1. RF Circuit Design – Theory and Applications by Reinhold Ludwig, Pavel Bsetchko – Pearson Education India, 2000.
2. Radio Frequency and Microwave Communication Circuits – Analysis and Design by Devendra K.Misra – Wiley Student Edition – John Wiley & Sons, Inc.

### **REFERENCES:**

1. Radio Frequency and Microwave Electronics – Illustrated by Matthew M. Radmanesh – PEI.
2. RF Circuit Design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. Secrets of RF Circuit Design by Joseph J.Carr, MC GRAW HILL EDUCATION, 2000.
4. Design of RF and Microwave Amplifiers and Oscillators, Peter L.D. Abrif, Artech House, 2000.
5. The Design of CMOS Radio Frequency Integrated Circuits by Thomas H.Lee , 2/e – Cambridge University Press, 2004.

**ARTIFICIAL NEURAL NETWORKS**  
(Professional Elective - II)

**B.Tech. IV Year I Sem.**

**Course Code: EC724PE/BM732PE**

|          |          |          |          |
|----------|----------|----------|----------|
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| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Objectives:**

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

**Course Outcomes:** By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

**UNIT - I**

**Introduction:** A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

**Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

**UNIT - II**

**Single Layer Perceptrons:** Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

**Multilayer Perceptron:** Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

**UNIT - III**

**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

**UNIT - IV**

**Self-Organization Maps (SOM):** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

**UNIT - V**

**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

**Hopfield Models** – Hopfield Models, Computer Experiment

**TEXT BOOKS:**

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.



**CELLULAR AND MOBILE COMMUNICATIONS**  
(Professional Elective - III)

**B.Tech. IV Year I Sem.**  
**Course Code: EC731PE**

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**Course Objectives:** The course objectives are:

- To provide the student with an understanding of the Cellular concept, Frequency reuse, Hand-off strategies.
- To enable the student to analyze and understand wireless and mobile cellular communication systems over a stochastic fading channel.
- To provide the student with an understanding of Co-channel and Non-Co-channel interferences.
- To give the student an understanding of cell coverage for signal and traffic, diversity techniques and mobile antennas.
- To give the student an understanding of frequency management, Channel assignment and types of handoff.

**Course Outcomes:** By the end of the course,

- The student will be able to analyze and design wireless and mobile cellular systems.
- The student will be able to understand impairments due to multipath fading channel.
- The student will be able understand the fundamental techniques to overcome the different fading effects.
- The student will be able to understand Co-channel and Non Co-channel interferences
- The student will be able to familiar with cell coverage for signal and traffic, diversity techniques and mobile antennas.
- The student will have an understanding of frequency management, Channel assignment, and types of handoff.

**UNIT - I**

**Introduction to Cellular Mobile Radio Systems:** Limitations of Conventional Mobile Telephone Systems, Basic Cellular Mobile System, First, Second, Third and Fourth Generation Cellular Wireless Systems, Uniqueness of Mobile Radio Environment- Fading - Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.

**Fundamentals of Cellular Radio System Design:** Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I From a Normal Case in a Omni Directional Antenna System, System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring, Microcell Zone Concept.

## **UNIT - II**

**Co-Channel Interference:** Measurement Of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and Their Effects, Diversity Techniques-Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity.

**Non-Co-Channel Interference:** Adjacent Channel Interference, Near End Far End Interference, Cross Talk, Effects on Coverage and Interference by Power Decrease, Antenna Height Decrease, Effects of Cell Site Components.

## **UNIT - III**

**Cell Coverage for Signal and Traffic:** Signal Reflections in Flat And Hilly Terrain, Effect of Human Made Structures, Phase Difference Between Direct and Reflected Paths, Constant Standard Deviation, Straight Line Path Loss Slope, General Formula for Mobile Propagation Over Water and Flat Open Area, Near and Long Distance Propagation, Path Loss From a Point to Point Prediction Model in Different Conditions, Merits of Lee Model.

**Cell Site and Mobile Antennas:** Space Diversity Antennas, Umbrella Pattern Antennas, Minimum Separation of Cell Site Antennas, Mobile Antennas.

## **UNIT - IV**

**Frequency Management and Channel Assignment:** Numbering And Grouping, Setup Access And Paging Channels, Channel Assignments to Cell Sites and Mobile Units, Channel Sharing and Borrowing, Sectorization, Overlaid Cells, Non Fixed Channel Assignment.

## **UNIT - V**

**Handoffs and Dropped Calls:** Handoff Initiation, Types of Handoff, Delaying Handoff, Advantages of Handoff, Power Difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoff, Intersystem Handoff, Introduction to Dropped Call Rates and their Evaluation.

## **TEXT BOOKS:**

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Mc Graw Hill, 2<sup>nd</sup> Edn., 1989.
2. Wireless Communications - Theodore. S. Rappoport, Pearson Education, 2<sup>nd</sup> Edn., 2002.
3. wireless communication and networks - Dalal, oxford university press

## **REFERENCE BOOKS:**

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International, 2<sup>nd</sup> Edn., 2001.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications Theory and Techniques, Asrar U. H .Sheikh, Springer, 2004.
4. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
5. Wireless Communications – Andrea Goldsmith, Cambridge University Press, 2005.

**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**  
(Professional Elective – III)

**B.Tech. IV Year I Sem.**  
**Course Code: EC732PE**

**L T P C**  
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**Course Objectives:**

- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:** On completion of this course student can be able to

- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

**UNIT - I**

**Block Schematics of Measuring Systems:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag ;Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

**UNIT - II**

**Signal Analyzers:** AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. **Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

**UNIT - III**

**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

**Special Purpose Oscilloscopes:** Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

#### **UNIT - IV**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

#### **UNIT - V**

**Bridges:** Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**Measurement of Physical Parameters:** Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

#### **TEXT BOOKS:**

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H. S. Kalsi – MC GRAW HILL EDUCATION, 2<sup>nd</sup> Edition 2004.
3. Electronic Instrumentation and Measurements – David A. Bell, 3rd Edition Oxford Univ. Press, 2013.

#### **REFERENCES:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbins, W.D. Cooper: PHI 5<sup>th</sup> Edition 2003.
3. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage MC GRAW HILL EDUCATION Reprint 2009.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

**ELECTROMAGNETIC INTERFERENCE & ELECTROMAGNETIC  
COMPATIBILITY (EMI & EMC)  
(Professional Elective –III)**

**B.Tech. IV Year I Sem.**  
**Course Code: EC733PE**

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**Course Objectives:**

1. To introduce important system concepts such as Electromagnetic interference and Electromagnetic compatibility (EMI & EMC).
2. To familiarize with unavoidable and naturally happening sources of EMI and problems to ensure EMC.
3. To study various techniques to reduce EMI from systems and to improve EMC of electronic systems.

**Course Outcomes:** Upon completion of this course, the student will be able to

1. Gain basic knowledge of problems associated with EMI and EMC from electronic circuits and systems.
2. Analyze various sources of EMI and various possibilities to provide EMC.
3. Understand and analyze possible EMI prevention techniques such as grounding, shielding, filtering and use of proper coupling mechanisms to improve compatibility of electronic circuits and systems in a given electromagnetic environment.

**UNIT – I**

**Sources of EMI:** Definition of EMI and EMC, Classification, Natural and Man-Made EMI Sources, Switching Transients, Electrostatic Discharge, Nuclear Electromagnetic Pulse and High Power Electromagnetics.

**EMI/EMC Standards:** Introduction, Standards for EMI/EMC – MIL –STD 461/462 – IEEE/ANSI Standards – CISPR/IEC, Standards – FCC Regulations.

**UNIT – II**

**EMI Coupling Modes:** Penetration: Introduction, Shielding Theory - Shielding Effectiveness, The Circuit Approach, The Wave Approach, Aperture Theory, Calculation of Effectiveness of a Conducting Box with an Aperture, Introduction to Propagation and Cross Talk – Introduction, Basic Principles, Determination of EM Field from Transmission Lines.

**UNIT – III**

**EMI Controlling Techniques - I:** Grounding, Principles and Practice of Earthing, Precautions in Earthing, Measurements of Ground Resistance, System Grounding for EMC, Cable Shielding Grounding.

Shielding, Theory and Effectiveness, Materials, Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Effectiveness Measurements, Electrical Bonding.

#### **UNIT – IV**

**EMI Controlling Techniques - II:** Characteristics and Types of Filters – Impedance Mismatch, Lumped Element Low-Pass, High-Pass, Band-Pass and Band-Reject Filters, Power Line Filter Design - Common Mode, Differential Mode, Combined CM and DM Filters, Design Example.

EMC Gaskets – Knitted Wire-Mesh Gaskets, Wire-Screen Gaskets, Oriented Wire Mesh, Conductive Elastomer, Transparent Conductive Windows, Conductive Adhesive, Conductive Grease, Conductive Coatings, Isolation Transformers, Opto-Isolators.

#### **UNIT - V**

**EMI Measurements:** Introduction to Open Area Test Site Measurements – Measurement Precautions – Open Area Test Site – Terrain Roughness – NSA – Measurement of Test Site Imperfections – Antenna Factor Measurement – Measurement Errors.

Radiated Interference Measurements – Anechoic Chamber – TEM Cell – Reverberating Chamber – Ghz TEM Cell – Comparison of Test Facilities – Measurement Uncertainties

Conducted Interference Measurements – Characterization – Conducted EM Noise on Power Supply Lines – Conducted EMI from Equipment – Immunity – Detectors and Measurement – Pulsed EMI Immunity – Electrostatic Discharge.

#### **TEXT BOOKS:**

1. Engineering Electromagnetic Compatibility – V. Prasad Kodali – 2/e – IEEE Press – Wiley India Pvt. Ltd – 2001.

#### **REFERENCES:**

1. Introduction to Electromagnetic Compatibility – Clayton R.Paul – John Wiley & Sons, 1992.
2. Electromagnetic Compatibility of Integrated Circuits – Techniques for Low Emission and Susceptibility – Edited by Sonia Ben Dhia, Mohamed Ramdani and Etienne Sicard – Springer, 2006.
3. EMI reduction in Electronic Systems – Mills – J.P – Prentice Hall Inc.
4. Noise Reduction in Electronic Systems – Henry W.Ott, 2<sup>nd</sup> Edition, Wiley Interscience, 1988.

**OBJECT ORIENTED PROGRAMMING THROUGH JAVA**  
(Professional Elective - III)

**B.Tech. IV Year I Sem.**  
**Course Code: EC734PE**

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**Course Objectives:**

- To introduce the object oriented programming concepts.
- To understand object oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
- To introduce the implementation of packages and interfaces
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using applets and swing controls.

**Course Outcomes**

- Able to solve real world problems using OOP techniques.
- Able to understand the use of abstract classes.
- Able to solve problems using java collection framework and I/o classes.
- Able to develop multithreaded applications with synchronization.
- Able to develop applets for web applications.
- Able to design GUI based applications

**UNIT - I**

**Object-oriented thinking-** A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances, Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts. Java buzzwords, An Overview of Java, Data types, Variables and Arrays, operators, expressions, control statements, Introducing classes, Methods and Classes, String handling.

**Inheritance**– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Polymorphism-ad hoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance.

**UNIT - II**

**Packages-** Defining a Package, CLASSPATH, Access protection, importing packages.

**Interfaces-** defining an interface, implementing interfaces, Nested interfaces, applying interfaces, variables in interfaces and extending interfaces.

**Stream based I/O(java.io)** – The Stream classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics.

**UNIT - III**

**Exception handling** - Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes.

**Multithreading**- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

**UNIT - IV**

**The Collections Framework (java.util)**- Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Accessing a Collection via an Iterator, Using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes and Interfaces- Dictionary, Hashtable ,Properties, Stack, Vector  
More Utility classes, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner

**UNIT - V**

**GUI Programming with Swing** – Introduction, limitations of AWT, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout.

**Event Handling**- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.

A Simple Swing Application, **Applets** – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets. Creating a Swing Applet, Painting in Swing, A Paint example, Exploring Swing Controls- JLabel and Image Icon, JText Field, The Swing Buttons- JButton, JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList, JCombo Box, Swing Menus, Dialogs.

**TEXT BOOKS**

1. Java The complete reference, 9<sup>th</sup> edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.

**REFERENCE BOOKS**

1. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
3. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
4. Programming in Java, S. Malhotra, S. Chudhary, 2<sup>nd</sup> edition, Oxford Univ. Press.
5. Java Programming and Object oriented Application Development, R. A. Johnson, Cengage Learning.



**OPTIMIZATION TECHNIQUES**  
(Professional Elective - IV)

**B.Tech. IV Year I Sem.**

**Course Code: EE733PE/EC741PE**

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**Prerequisite:** Mathematics –I & Mathematics –II

**Course Objectives:**

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

**Course Outcomes:** After completion of this course, the student will be able to

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

**UNIT – I**

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**

**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems.

### UNIT – III

**Unconstrained Nonlinear Programming:** One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques:** Univariate method, Powell’s method and steepest descent method.

### UNIT – IV

**Constrained Nonlinear Programming:** Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

### UNIT – V

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

### TEXT BOOKS:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4<sup>th</sup> edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

### REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in operations research 3<sup>rd</sup> edition, 2003.
2. H.A. Taha, “Operations Research: An Introduction”, 8<sup>th</sup> Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, “Optimization for Engineering Design – Algorithms and Examples”, PHI Learning Pvt. Ltd, New Delhi, 2005.

**EMBEDDED SYSTEM DESIGN**  
(Professional Elective - IV)

**B.Tech. IV Year I Sem.**

**Course Code: EI701PC/EC742PE**

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**Course Objectives:**

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.

**Course Outcomes:**

- Expected to understand the selection procedure of Processors in the embedded domain.
- Design Procedure for Embedded Firmware.
- Expected to visualize the role of Real time Operating Systems in Embedded Systems.
- Expected to evaluate the Correlation between task synchronization and latency issues

**UNIT - I**

**Introduction to Embedded Systems:** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

**UNIT - II**

**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS).  
**Memory:** ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

**UNIT - III**

**Embedded Firmware:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

**UNIT - IV**

**RTOS Based Embedded System Design:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

**UNIT - V**

**Task Communication:** Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

**TEXT BOOKS:**

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

**REFERENCE BOOKS:**

1. Embedded Systems - Raj Kamal, MC GRAW HILL EDUCATION.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

**SATELLITE COMMUNICATIONS**  
(Professional Elective - IV)

**B.Tech. IV Year I Sem.**

**L T P C**

**Course Code: EC743PE**

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**Course Objectives:** The course objectives are:

- To prepare students to excel in basic knowledge of satellite communication principles
- To provide students with solid foundation in orbital mechanics and launches for the satellite communication
- To train the students with a basic knowledge of link design of satellite with a design examples.
- To provide better understanding of multiple access systems and earth station technology
- To prepare students with knowledge in satellite navigation and GPS & and satellite packet communications.

**Course Outcomes:** At the end of the course,

- Students will understand the historical background, basic concepts and frequency allocations for satellite communication
- Students will demonstrate orbital mechanics, launch vehicles and launchers
- Students will demonstrate the design of satellite links for specified C/N with system design examples.
- Students will be able to visualize satellite sub systems like Telemetry, tracking, command and monitoring power systems etc.
- Students will understand the various multiple access systems for satellite communication systems and satellite packet communications.

**UNIT - I**

**Introduction:** Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

**Orbital Mechanics and Launchers:** Orbital Mechanics, Look Angle determination, Orbital Perturbations, Orbit determination, Launches and Launch vehicles, Orbital Effects in Communication Systems Performance.

**UNIT - II**

**Satellite Subsystems:** Attitude and Orbit Control System, Telemetry, Tracking, Command And Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.

### **UNIT - III**

**Satellite Link Design:** Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design Of Satellite Links For Specified C/N, System Design Examples.

**Multiple Access:** Frequency Division Multiple Access (FDMA), Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA), Frame Structure, Examples, Satellite Switched TDMA Onboard Processing, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception.

### **UNIT - IV**

**Earth Station Technology:** Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods.

### **UNIT - V**

**Low Earth Orbit and Geo-Stationary Satellite Systems:** Orbit Considerations, Coverage and Frequency Consideration, Delay & Throughput Considerations, System Considerations, Operational NGSO Constellation Designs.

**Satellite Navigation & Global Positioning System :** Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, GPS Receiver Operation, GPS C/A Code Accuracy, Differential GPS.

### **TEXT BOOKS:**

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

### **REFERENCES:**

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2<sup>nd</sup> Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5<sup>th</sup> Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004  
Satellite Communications – Dennis Roddy, McGraw Hill, 4<sup>th</sup> Edition, 2009.

**NETWORK SECURITY AND CRYPTOGRAPHY**  
(Professional Elective - IV)

**B.Tech. IV Year I Sem.**

**L T P C**

**Course Code: EM731PE/EC744PE**

**3 0 0 3**

**Course Objectives:**

- Understand the basic concept of Cryptography and Network Security, their mathematical models
- To provide deeper understanding of application to network security, threats/vulnerabilities to networks and countermeasures
- To create an understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works
- To provide familiarity in Intrusion detection and Firewall Design Principles

**Course Outcomes:** After completion of this course, the student shall be able to:

- Describe computer and network security fundamental concepts and principles
- Identify and assess different types of threats, malware, spyware, viruses, vulnerabilities
- Encrypt and decrypt messages using block ciphers
- Describe the inner-workings of today's remote exploitation and penetration techniques
- Describe the inner-workings of popular encryption algorithms, digital signatures, certificates, anti-cracking techniques, and copy-right protections
- Demonstrate the ability to select among available network security technology and protocols such as IDS, IPS, firewalls, SSL, SSH, IPsec, TLS, VPNs, etc.
- Analyze key agreement algorithms to identify their weaknesses

**UNIT - I**

**Introduction:** Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

**Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

**UNIT – II**

**Encryption:** Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block ciphers.

**Conventional Encryption:** Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

**UNIT – III**

**Public Key Cryptography:** Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

**Number Theory:** Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

#### **UNIT – IV**

**Message Authentication and Hash Functions:** Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

**Hash and Mac Algorithms:** MD File, Message digest Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards.

**Authentication Applications:** Kerberos, Electronic Mail Security: Pretty Good Privacy, S/MIME.

#### **UNIT – V**

**IP Security:** Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, secure sockets layer, and Transport layer security, Secure Electronic Transaction.

**Intruders, Viruses and Worms:** Intruders, Viruses and Related threats.

**Fire Walls:** Fire wall Design Principles, Trusted systems.

#### **TEXT BOOKS:**

1. Cryptography and Network Security: Principles and Practice - William Stallings, Pearson Education.
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.

#### **REFERENCE BOOKS:**

1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press)
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Principles of Information Security, Whitman, Thomson.
4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
5. Introduction to Cryptography, Buchmann, Springer.



**VLSI DESIGN****B.Tech. IV Year I Sem.****Course Code: EC702PC/ET721PE/EI741PE****L T P C****4 0 0 4****Course Objectives:** The objectives of the course are to:

1. Give exposure to different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors, and passive components.
2. Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
3. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
4. Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
5. Provide design concepts to design building blocks of data path of any system using gates.
6. Understand basic programmable logic devices and testing of CMOS circuits.

**Course Outcomes:** Upon successfully completing the course, the student should be able to:

1. Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
2. Choose an appropriate inverter depending on specifications required for a circuit
3. Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit
4. Design different types of logic gates using CMOS inverter and analyze their transfer characteristics
5. Provide design concepts required to design building blocks of data path using gates.
6. Design simple memories using MOS transistors and can understand design of large memories.
7. Design simple logic circuit using PLA, PAL, FPGA and CPLD.
8. Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system

**UNIT – I****Introduction:** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS**Basic Electrical Properties:** Basic Electrical Properties of MOS and BiCMOS Circuits:  $I_{ds}$ - $V_{ds}$  relationships, MOS transistor threshold Voltage,  $g_m$ ,  $g_{ds}$ , Figure of merit  $\omega_0$ ; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.**UNIT - II****VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2  $\mu$ m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

### **UNIT – III**

**Gate Level Design:** Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

### **UNIT - IV**

**Data Path Subsystems:** Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

**Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memories.

### **UNIT - V**

**Programmable Logic Devices:** PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.

**CMOS Testing:** CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

### **TEXT BOOKS:**

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, PHI, 2005 Edition
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3<sup>rd</sup> Ed, Pearson, 2009.

### **REFERENCE BOOKS:**

1. CMOS logic circuit Design - John .P. Uyemura, Springer, 2007.
2. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.

**VLSI & E-CAD LAB**

**B.Tech. IV Year I Sem.**  
**Course Code: EC703PC**

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

**List of Experiments**

Design and implementation of the following CMOS digital/analog circuits using **Cadence / Mentor Graphics / Synopsys /Equivalent** CAD tools. The design shall include Gate-level design, Transistor-level design, Hierarchical design, Verilog HDL/VHDL design, Logic synthesis, Simulation and verification, Scaling of CMOS Inverter for different technologies, study of secondary effects ( temperature, power supply and process corners), Circuit optimization with respect to area, performance and/or power, Layout, Extraction of parasitics and back annotation, modifications in circuit parameters and layout consumption, DC/transient analysis, Verification of layouts (DRC, LVS)

**E-CAD programs:**

Programming can be done using any compiler. Down load the programs on FPGA/CPLD boards and performance testing may be done using pattern generator (32 channels) and logic analyzer apart from verification by simulation with any of the front end tools.

1. HDL code to realize all the logic gates
2. Design of 2-to-4 decoder
3. Design of 8-to-3 encoder (without and with priority)
4. Design of 8-to-1 multiplexer and 1-to-8 demultiplexer
5. Design of 4 bit binary to gray code converter
6. Design of 4 bit comparator
7. Design of Full adder using 3 modeling styles
8. Design of flip flops: SR, D, JK, T
9. Design of 4-bit binary, BCD counters ( synchronous/ asynchronous reset) or any sequence counter
10. Finite State Machine Design

**VLSI programs:**

- Introduction to layout design rules. Layout, physical verification, placement & route for complex design, static timing analysis, IR drop analysis and crosstalk analysis of the following:
  1. Basic logic gates
  2. CMOS inverter
  3. CMOS NOR/ NAND gates
  4. CMOS XOR and MUX gates
  5. Static / Dynamic logic circuit (register cell)
  6. Latch
  7. Pass transistor
  8. Layout of any combinational circuit (complex CMOS logic gate).
  9. Analog Circuit simulation (AC analysis) – CS & CD amplifier

**Note:** Any **SIX** of the above experiments from each part are to be conducted (Total 12)

**MICROWAVE ENGINEERING LAB**

**B.Tech. IV Year I Sem.**  
**Course Code: EC704PC**

**L T P C**  
**0 0 3 2**

**Note: Minimum of 12 experments to be conducted**

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Directional Coupler Characteristics
4. VSWR Measurement of Mached load
5. VSWR mesurement of with open and short circuit loads
6. Measurement of Waveguide Parameters
7. Measurement of Impedance of a given Load
8. Measurement of Scattering Parameters of a E plane Tee
9. Measurement of Scattering Parameters of a H plane Tee
10. Measurement of Scattering Parameters of a Magic Tee
11. Measurement of Scattering Parameters of a Circulator
12. Attenuation Measurement
13. Microwave Frequency Measurement
14. Antenna Pattern Measurements.

**OPTICAL COMMUNICATIONS**  
(Professional Elective - V)

**B.Tech. IV Year II Sem.**  
**Course Code: EC851PE**

**L T P C**  
**3 0 0 3**

**Course Objectives:** The objectives of the course are:

- To realize the significance of optical fibre communications.
- To understand the construction and characteristics of optical fibre cable.
- To develop the knowledge of optical signal sources and power launching.
- To identify and understand the operation of various optical detectors.
- To understand the design of optical systems and WDM.

**Course Outcomes:** At the end of the course, the student will be able to:

- Understand and analyze the constructional parameters of optical fibres.
- Be able to design an optical system.
- Estimate the losses due to attenuation, absorption, scattering and bending.
- Compare various optical detectors and choose suitable one for different applications.

**UNIT - I**

**Overview of Optical Fiber Communication:** - Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers.

**Single Mode Fibers-** Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index, Fiber Materials Glass, Halide, Active Glass, Chalcogenide Glass, Plastic Optical Fibers.

**UNIT - II**

**Signal Distortion in Optical Fibers:** Attenuation, Absorption, Scattering and Bending Losses, Core and Cladding Losses, Information Capacity Determination, Group Delay, Types of Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion, Intermodal Dispersion, Pulse Broadening, Optical Fiber Connectors- Connector Types, Single Mode Fiber Connectors, Connector Return Loss.

**UNIT - III**

**Fiber Splicing:** Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints.

**Optical Sources-** LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD.

**Source to Fiber Power Launching:** - Output Patterns, Power Coupling, Power Launching, Equilibrium Numerical Aperture, Laser Diode to Fiber Coupling.

#### **UNIT - IV**

**Optical Detectors:** Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation- Fundamental Receiver Operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, Probability of Error, Quantum Limit, Analog Receivers.

#### **UNIT - V**

**Optical System Design:** Considerations, Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion in Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples.

Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

#### **TEXT BOOKS:**

1. Optical Fiber Communications – Gerd Keiser, MC GRAW HILL EDUCATION, 4<sup>th</sup> Edition, 2008.
2. Optical Fiber Communications – John M. Senior, Pearson Education, 3<sup>rd</sup> Edition, 2009.

#### **REFERENCE BOOKS:**

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Introduction to Fiber Optics by Donald J. Sterling Jr. – Cengage learning, 2004.

**WIRELESS COMMUNICATIONS AND NETWORKS**  
(Professional Elective -V)

**B.Tech. IV Year II Sem.**  
**Course Code: EC852PE**

| L | T | P | C |
|---|---|---|---|
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**Course objectives:** The course objectives are:

- To provide the students with the fundamental treatment about many practical and theoretical concepts that forms basic of wireless communications.
- To equip the students with various kinds of wireless networks and its operations.
- To prepare students to understand the concept of frequency reuse, and be able to apply it in the design of mobile cellular system.
- To prepare students to understand various modulation schemes and multiple access techniques that are used in wireless communications,
- To provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks, and to discuss the nature of, and solution methods to, the fundamental problems in wireless networking.
- To train students to understand the architecture and operation of various wireless wide area networks such as GSM, IS-95, GPRS and SMS.
- To train students to understand wireless LAN architectures and operation.
- To prepare students to understand the emerging technique OFDM and its importance in the wireless communications.

**Course Outcomes:** Upon completion of the course, the student will be able to:

- Understand the principles of wireless communications.
- Understand fundamentals of wireless networking
- Understand cellular system design concepts.
- Analyze various multiple access schemes used in wireless communication.
- Understand wireless wide area networks and their performance analysis.
- Demonstrate wireless local area networks and their specifications.
- Familiar with some of the existing and emerging wireless standards.
- Understand the concept of orthogonal frequency division multiplexing.

### **UNIT - I**

#### **The Cellular Concept-System Design Fundamentals**

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

**UNIT – II****Mobile Radio Propagation: Large-Scale Path Loss**

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from perfect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

**UNIT – III****Mobile Radio Propagation: Small –Scale Fading and Multipath**

Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

**UNIT - IV****Equalization and Diversity**

Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

**UNIT - V****Wireless Networks**

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access



Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

**TEXT BOOKS:**

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2<sup>nd</sup> Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE

**REFERENCE BOOKS:**

1. Wireless Communication and Networking – William Stallings, 2003, PHI.

**DESIGN OF FAULT TOLERANT SYSTEMS**  
(Professional Elective - V)

**B.Tech. IV Year II Sem.**  
**Course Code: EC853PE**

**L T P C**  
**3 0 0 3**

**Course Objectives:**

1. To provide or broad understanding of fault diagnosis and tolerant design Approach.
2. To illustrate the framework of test pattern generation using semi and full automatic approach.

**Course Outcomes:**

- 1) To acquire the knowledge of fundamental concepts in fault tolerant design.
- 2) Design requirements of self check-in circuits
- 3) Test pattern generation using LFSR
- 4) Design for testability rules and techniques for combinational circuits
- 5) Introducing scan architectures.
- 6) Design of built-in-self test.

**UNIT – I**

**Fault Tolerant Design:** Basic concepts: Reliability concepts, Failures & faults, Reliability and Failure rate, Relation between reliability and mean time between failure, maintainability and availability, reliability of series, parallel and parallel-series combinational circuits.  
**Fault Tolerant Design:** Basic concepts-static, dynamic, hybrid, triple modular redundant system (TMR), 5MR reconfiguration techniques, Data redundancy, Time redundancy and software Redundancy concepts.

**UNIT – II**

**Self Checking circuits & Fail safe Design:** Self Checking Circuits: Basic concepts of self checking circuits, Design of Totally self checking checker, Checkers using m out of n codes, Berger code, Low cost residue code.  
 Fail Safe Design: Strongly fault secure circuits, fail safe design of sequential circuits using partition theory and Berger code, totally self checking PLA design.

**UNIT - III**

**Design for Testability:** Design for testability for combinational circuits: Basic concepts of Testability, Controllability and observability, The Reed Muller's expansion technique, use of control and syndrome testable designs.

**Design for testability by means of scan:**

Making circuits Testable, Testability Insertion, Full scan DFT technique- Full scan insertion, flip-flop Structures, Full scan design and Test, Scan Architectures-full scan design, Shadow register DFT, Partial scan methods, multiple scan design, other scan designs.

**UNIT - IV**

**Logic Built-in-self-test:** BIST Basics-Memory-based BIST, BIST effectiveness, BIST types, Designing a BIST, Test Pattern Generation-Engaging TPGs, exhaustive counters, ring counters, twisted ring counter, Linear feedback shift register, Output Response Analysis-Engaging ORA's, One's counter, transition counter, parity checking, Serial LFSRs, Parallel Signature analysis, BIST architectures-BIST related terminologies, A centralized and separate Board-level BIST architecture, Built-in evaluation and self test(BEST), Random Test socket(RTS), LSSD On-chip self test, Self –testing using MISR and SRSG, Concurrent BIST, BILBO, Enhancing coverage, RT level BIST design-CUT design, simulation and synthesis, RTS BIST insertion, Configuring the RTS BIST, incorporating configurations in BIST, Design of STUMPS, RTS and STUMPS results.

**UNIT – V**

**Standard IEEE Test Access Methods:** Boundary Scan Basics, Boundary scan architecture-Test access port, Boundary scan registers, TAP controller, the decoder unit, select and other units, Boundary scan Test Instructions-Mandatory instructions, Board level scan chain structure-One serial scan chain, multiple-scan chain with one control test port, multiple-scan chains with one TDI, TDO but multiple TMS, Multiple-scan chain, multiple access port, RT Level boundary scan-inserting boundary scan test hardware for CUT, Two module test case, virtual boundary scan tester, Boundary Scan Description language.

**TEXTBOOKS:**

1. Fault Tolerant & Fault Testable Hardware Design- Parag K.Lala, 1984, PHI
2. Digital System Test and Testable Design using HDL models and Architectures - Zainalabedin Navabi, Springer International Edition.

**REFERENCES:**

1. Digital Systems Testing and Testable Design-Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books
2. Essentials of Electronic Testing- Bushnell & Vishwani D. Agarwal, Springers.
3. Design for Test for Digital IC's and Embedded Core Systems- Alfred L. Crouch, 2008, Pearson Education.

**BIOMEDICAL INSTRUMENTATION**  
(Professional Elective – V)

**B.Tech. IV Year II Sem.**  
**Course Code: EC854PE**

**L T P C**  
**3 0 0 3**

**Course Objective:** Introduction to various Concepts of Medical Instrumentation.

**Course Outcome:** The student is expected to know the working and design of instruments used in Health care

**UNIT – I**

**Components of Medical Instrumentation System:** Bioamplifier. Static and dynamic characteristics of medical instruments. Biosignals and characteristics. Problems encountered with measurements from human beings.

**UNIT – II**

**Organization of cell:** Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential, Conduction through nerve to neuromuscular junction.

**Bio Electrodes:** Biopotential Electrodes-External electrodes, Internal Electrodes. Biochemical Electrodes.

**UNIT – III**

**Mechanical function:** Electrical Conduction system of the heart. Cardiac cycle. Relation between electrical and mechanical activities of the heart.

**Cardiac Instrumentation:** Blood pressure and Blood flow measurement. Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart.

**UNIT – IV**

**Neuro-Muscular Instrumentation:** Specification of EEG and EMG machines. Electrode placement for EEG and EMG recording. Interpretation of EEG and EMG.

**UNIT – V**

**Therapeutic equipment:** Pacemaker, Defibrillator, Shortwave diathermy. Haemodialysis machine. **Respiratory Instrumentation:** Mechanism of respiration, Spirometry, Pneumotachograph Ventilators.

**TEXT BOOKS:**

1. Hand-book of Biomedical Instrumentation – by R.S. Khandpur, McGraw-Hill, 2003.
2. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.

**REFERENCE BOOKS:**

1. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John Wiley and Sons.
2. Biomedical Equipment Technology – Carr & Brown, Pearson.

**RADAR SYSTEMS**  
(Professional Elective -VI)

**B.Tech. IV Year II Sem.**  
**Course Code: EC861PE**

**L T P C**  
**3 0 0 3**

**Course Objectives:** This is a system oriented course and needs the knowledge of Signal and Systems, EM Theory and Transmission Lines, Antennas and Wave Propagation, and Microwave Engineering. The main objectives of this course are:

- To understand the working principle of a radar, identify the frequency bands, and formulate the complete radar range equation, listing out all the losses to be accounted for.
- To identify the need for modulation and Doppler effect; to get acquainted with the working principles of CW radar, FM-CW radar.
- To impart the knowledge of functioning of MTI radar and its variants; to establish the DLC features and to bring out the MTI radar performance limitations.
- To establish the principle of Tracking Radar and differentiate between different types of tracking radars, identifying their principle of operation with necessary schematics.
- To explain the concept of a Matched Filter in radar receiver, and to configure its response characteristics; to impart the working knowledge of different receiver blocks – duplexers, displays, phased array antennas, their requirements and utilities.

**Course Outcomes:** Having gone through this course on Radar Systems, the students would be able to:

- Explain the working principle of a pulse radar and establish the complete radar range equation, identifying the significance and choice of all parameters involved, and solve numerical problems to establish the radar characteristics.
- Account for the need and functioning of CW, FM-CW and MTI radars, identifying the complete block diagrams and establishing their characteristics.
- Illustrate the DLC characteristics, account for the range gated Doppler filter bank, and estimate the MTI radar performance characteristics and limitations.
- Distinguish between Sequential Lobing, Conical Scan, Monopulse type of Tracking Radars, specify their requirements and compare their characteristic features.
- Derive the matched filter response characteristics for radar applications and account for correlation receivers; to distinguish between different radar displays and duplexers.
- Account for the electronic scanning principle, and implement the same through phased array antennas, knowing their requirements and utilities.

**UNIT – I**

**Basics of Radar** : Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems.

**Radar Equation** : SNR, Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets , Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

**UNIT – II**

**CW and Frequency Modulated Radar** : Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. Illustrative Problems

**FM-CW Radar**: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter.

**UNIT - III**

**MTI and Pulse Doppler radar**: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

**UNIT – IV**

**Tracking Radar**: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

**UNIT – V**

**Detection of Radar Signals in Noise** : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

**Radar Receivers** – Noise Figure and Noise Temperature, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.

**TEXT BOOKS:**

1. Introduction to Radar Systems – Merrill I. Skolnik, MC GRAW HILL EDUCATION Special Indian Edition, 2<sup>nd</sup> Ed., 2007.

**REFERENCE BOOKS:**

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.

3. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013
4. Introduction to Radar Systems, 3<sup>rd</sup> edition – M.I. Skolnik, MC GRAW HILL EDUCATION Ed., 2005

**CODING THEORY AND TECHNIQUES**  
(Professional Elective - VI)

**B.Tech. IV Year II Sem.**  
**Course Code: EC862PE**

**L T P C**  
**3 0 0 3**

**Course Objectives:**

- To acquire the knowledge in measurement of information and errors.
- To study the generation of various code methods.
- To study the various application of codes.

**Course Outcomes:**

- Learning the measurement of information and errors.
- Obtain knowledge in designing various codes like block codes, cyclic codes, convolution codes, turbo codes and space codes.

**UNIT – I**

**Coding for Reliable Digital Transmission and storage:** Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

**UNIT - II**

**Cyclic Codes:** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

**UNIT – III**

**Convolutional Codes:** Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority - logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

**UNIT – IV**

**Turbo Codes:** LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding



## **UNIT - V**

**Space-Time Codes:** Introduction, Digital modulation schemes, Diversity, Orthogonal space-Time Block codes, Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing : General Concept, Iterative APP Preprocessing and Per-layer Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition and Interface Cancellation, Performance of Multi – Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

### **TEXT BOOKS:**

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill

### **REFERENCE BOOKS:**

1. Error Correcting Coding Theory-Man Young Rhee-1989,McGraw Hill Publishing,19
2. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
3. Digital Communications- John G. Proakis, 5<sup>th</sup> ed., 2008, MCGRAW HILL EDUCATION.
4. Introduction to Error Control Codes-Salvatore Gravano-oxford
5. Error Correction Coding – Mathematical Methods and Algorithms – Todd K. Moon, 2006, Wiley India.
6. Information Theory, Coding and Cryptography – Ranjan Bose, 2<sup>nd</sup> Edition, 2009, MC GRAW HILL EDUCATION.

**DATABASE MANAGEMENT SYSTEMS**  
(Professional Elective -VI)

**B.Tech. IV Year II Sem.**

**Course Code: ET854PE/EC863PE**

| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------|----------|----------|----------|
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Objectives:**

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

**Course Outcomes:**

- Demonstrate the basic elements of a relational database management system.
- Ability to identify the data models for relevant problems.
- Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.
- Apply normalization for the development of application software.

**UNIT - I**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Data base design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT - II**

**Relational Algebra and Calculus:** Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases..

### **UNIT - III**

**Schema Refinement and Normal Forms:** Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

### **UNIT - IV**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

### **UNIT - V**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

Tree-Structured Indexing: Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

**Hash- Based Indexing:** Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

### **TEXT BOOKS:**

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3<sup>rd</sup> Edition. (**Part of UNIT-I, UNIT-II, UNIT-III, UNIT-V**)
2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited 1, 6<sup>th</sup> edition.( **Part of UNIT-I, UNIT-IV**)

### **REFERENCE BOOKS:**

1. Database Systems, 6<sup>th</sup> edition, R Elmasri, Shamkant B.Navathe, Pearson Education.
2. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning.
3. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition.
4. Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.
5. Introduction to Database Systems, C. J. Date, Pearson Education.

**GLOBAL POSITIONING SYSTEM**  
**(Professional Elective - VI)**

**B.Tech. IV Year II Sem.**  
**Course Code: EC864PE**

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**UNIT - I**

**Introduction:** Basic concept, system architecture, GPS and GLONASS Overview, Satellite Navigation, Time and GPS, User position and velocity calculations, GPS, Satellite Constellation, Operation Segment, User receiving Equipment, Space Segment Phased development, GPS aided Geoaugmented navigation (GAGAN) architecture.

**UNIT - II**

**Signal Characteristics:** GPS signal components, purpose, properties and power level, signal acquisition and tracking , Navigation information extraction, pseudorange estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

**UNIT - III**

**GPS Receivers & Data Errors:** Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error, estimation using dual frequency GPS receiver, Methods of multipath mitigation, Ephemeris data errors, clock errors.

**UNIT - IV**

**Differential GPS:** Introduction, LADGPS, WADGPS, Wide Area Augmentation systems , GEO Uplink subsystem , GEO downlink systems , Geo Orbit determination , Geometric analysis , covariance analysis , GPS /INS Integration Architectures

**UNIT - V**

**GPS Applications:** GPS in surveying, Mapping and Geographical Information System, Precision approach Aircraft landing system, Military and Space application, intelligent transportation system.

GPS orbital parameters, description of receiver independent exchange format (RINEX) , Observation data and navigation message data parameters, GPS position determination, least squares method

**TEXT BOOKS:**

1. Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, “Global positioning systems, Inertial Navigation and Integration”, Wiley 2007.

**REFERENCES:**

1. E.D.Kaplan, Christopher J. Hegarty, “Understanding GPS Principles and Applications”, Artech House Boston 2005.

**B.TECH. AERONAUTICAL ENGINEERING  
INTRODUCTION TO SPACE TECHNOLOGY  
(OPEN ELECTIVE - I)**

**B.Tech. III Year I Sem.**  
**Course Code: AE511OE**

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**UNIT - I**

**Fundamentals of Rocket Propulsion and Trajectories:** Space Mission- Types-Space environment-launch vehicle selection.; Introduction to rocket propulsion-fundamentals of solid propellant rockets- Fundamentals of liquid propellant rockets-Rocket equation, Two-dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two multi-stage rockets-Trade-off ratios-Single stage to orbit- Sounding rocket-Aerospace plane-Gravity turn trajectories-Impact point calculation-Injection conditions-Flight dispersions

**UNIT- II**

**Atmospheric Re-entry:** Introduction-Steep ballistic re-entry-Ballistic orbital re-entry-Skip re-entry-“Double- Dip” re-entry - Aero-braking - Lifting body re-entry

**UNIT-III**

**Fundamentals of Orbital Mechanics, Orbital Manoeuvres:** Two-body motion-circular, elliptic, hyperbolic, and parabolic orbits-Basic orbital elements-Ground trace. In-Plane orbit changes-Hohmann transfer-Bi-elliptical transfer-Plane changes- Combined manoeuvres-Propulsion for manoeuvres

**UNIT - IV**

**Satellite Attitude Dynamics:** Torque free axisymmetric rigid body-Attitude control for spinning spacecraft - Attitude control for non-spinning spacecraft - The Yo-Yo mechanism – Gravity – Gradient satellite-Dual spin spacecraft-Attitude determination

**UNIT-V**

**Space mission Operations:** Supporting ground system architecture and team interfaces - Mission phases and core operations- Team responsibilities – Mission diversity – Standard operations practices

**TEXT BOOK:**

1. ‘Spaceflight Dynamics’, W.E. Wiesel, 3<sup>rd</sup> edition, McGraw-Hill, 2010

**REFERENCES**

1. ‘Rocket Propulsion and Space flight dynamics’, Cornelisse JW, Schoyer HFR, and Wakker KF, Pitman, 1984
2. ‘Fundamentals of Space Systems’, Vincet L. Pisacane, Oxford University Press, 2005.
3. ‘Understanding Space: An Introduction to Astronautics’, J. Sellers, 2<sup>nd</sup> edition, McGraw- Hill, 2004

4. 'Introduction to Space Flight', Francis J Hale, Prentice-Hall, 1994
5. 'Spacecraft Mission Design', Charles D. Brown, AIAA Education Series, 1998
6. 'Elements of Space Technology for Aerospace Engineers', Meyer Rudolph X, Academic Press, 1999

**B.TECH. AERONAUTICAL ENGINEERING  
INTRODUCTION TO AEROSPACE ENGINEERING  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: AE6210E**

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**UNIT – I**

**History of Flight and Space Environment:** Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth's atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments.

**UNIT – II**

**Introduction to Aerodynamics:** Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, Mach number, centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves; Different types of drag.

**UNIT – III**

**Flight Vehicle Performance and Stability:** Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric manoeuvres, turns, sideslips, takeoff and landing; Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes.

**UNIT – IV**

**Introduction to Airplane Structures and Materials, Power Plants:** General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminium alloy, titanium, stainless steel and composite materials. Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

**UNIT – V**

**Satellite Systems Engineering Human Space Exploration:** Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, The Soviet and US missions; The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle; International

Space Station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, Flight safety; Indian effort in aviation, missile and space technology.

**TEXT BOOKS:**

1. Anderson J. D, "Introduction to Flight", McGraw-Hill, 5<sup>th</sup> Edition, 1989.
2. Newman D, "Interactive Aerospace Engineering and Design", McGraw-Hill, 1<sup>st</sup> Edition, 2002.
3. Barnard R.H and Philpot. D.R, "Aircraft Flight", Pearson, 3<sup>rd</sup> Edition, 2004.

**REFERENCES**

1. Kermode, A. C, "Flight without Formulae", McGraw Hill, 4<sup>th</sup> Edition, 1997.
2. Swatton P. J, "Flight Planning", Blackwell Publisher, 6<sup>th</sup> Edition, 2002.



**B.TECH. AERONAUTICAL ENGINEERING**  
**AIR TRANSPORTATION SYSTEMS**  
**(OPEN ELECTIVE - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE831OE**

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**UNIT- I**

**Aviation Industry & Its Regulatory Authorities:** Introduction, history of aviation- evolution, development, growth, challenges. Aerospace industry, air transportation industry- economic impact- types and causes. Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

**UNIT-II**

**Airspace:** Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses. Communication, navigation and surveillance systems (CNSS). Radio communications- VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems( R-Nav), ILS, MLS, GPS, INS.

**UNIT- III**

**Aircraft:** Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness- payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

**UNIT- IV**

**Airports:** Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area- airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

**UNIT - V**

**Airlines:** Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, computerized reservation systems, yield management. Integrating service quality into the revenue-generation process.

Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

**TEXT BOOK:**

1. Hirst, M., *The Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

**REFERENCES:**

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Eighth Edition, shgate, 2015.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Second Edition, Wiley, 2015.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Second Edition, Ashgate, 2010.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 5<sup>th</sup> edn., Thomson Learning, 2011.
5. Wells, A. and Young, S., *Airport Planning and Management*, 6<sup>th</sup> edn., McGraw-Hill, 2011.

**B.TECH. AERONAUTICAL ENGINEERING  
ROCKETS AND MISSILES  
(OPEN ELECTIVE - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE832OE**

**L T P C**  
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**UNIT- I**

**Introduction:** Space launch vehicles and military missiles- function, types, role, mission, mission profile, thrust profile, propulsion system, payload, staging, control and guidance requirements, performance measures, design, construction, operation- similarities and differences.

**UNIT – II**

**Solid and Liquid Propulsion Systems:** Solid propellant rocket motors, principal features, applications. Solid propellants- types, composition, properties, performance. Propellant grain-desirable properties, grain configurations, Liners, insulators and inhibitors-function, requirements, materials. Rocket motor casing-materials. Combustion system of solid rockets, igniters, types, construction. Nozzles-types, Liquid propellants- types, composition, properties, performance. Propellant tanks feed systems- pressurisation, turbo-pumps- valves and feed lines, injectors, starting and ignition. Engine cooling, support structure, control of engine starting and thrust build-up, liquid rocket combustion chamber

**UNIT – III**

**Aerodynamics of Rockets and Missiles:** Classification of missiles. Airframe components of rockets and missiles, Forces acting on a missile while passing through atmosphere, method of describing aerodynamic forces and moments, lateral aerodynamic moment, lateral damping moment, longitudinal moment of a rocket, lift and drag forces, drag estimation, body upwash and downwash in missiles. Rocket dispersion, re-entry body design considerations

**UNIT - IV**

**Dynamics and Control of Rockets and Missiles:** Tsiolskovsky's rocket equation- range in the absence of gravity, vertical motion in the earth's gravitational field, inclined motion, flight path at constant pitch angle, motion in the atmosphere, the gravity turn- the culmination altitude. Multi-staging. Earth launch trajectories- vertical segment, the gravity turn, constant pitch trajectory, orbital injection; Rocket thrust vector control-methods of thrust vector control for solid and liquid propulsion systems, thrust magnitude control, thrust termination

**UNIT - V**

**Rocket Testing:** Ground testing and flight testing- types of tests, test facilities and safeguards, monitoring and control of toxic materials, instrumentation and data management. Ground testing, flight testing, trajectory monitoring, post accident procedures, Description of a typical space vehicle launch procedure.

**TEXT BOOKS:**

1. Sutton, G.P., and Biblarz, O., *Rocket Propulsion Elements*, 8<sup>th</sup> edition, Wiley-Interscience, 2010.
2. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics*, Pitman, 1979.
3. Turner, M.J.L., *Rocket and Spacecraft Propulsion*, 3<sup>rd</sup> edition, Springer, 2009.

**REFERENCES**

1. Chin, S.S., *Missile Configuration Design*, McGraw Hill, 1961
2. Ball, K.J., Osborne, G.F., *Space Vehicle Dynamics*, Oxford University Press, 1967.

**B.TECH. AUTOMOBILE ENGINEERING  
DISASTER MANAGEMENT  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: CE511OE**

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**Course Objectives:** The subject provides different disasters, tools and methods for disaster management.

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

**UNIT - II**

**Disaster Management Mechanism:** Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

**UNIT - III**

**Capacity Building:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

**UNIT - IV**

**Coping with Disaster:** Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

**UNIT - V**

**Planning for disaster management:** Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

**TEXT BOOKS:**

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (<http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf>)

**B.TECH. AUTOMOBILE ENGINEERING  
INTELLECTUAL PROPERTY RIGHTS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT512OE**

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**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

**B.TECH. AUTOMOBILE ENGINEERING**  
**DATA STRUCTURES**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**

**L T P C**

**Course Code: EM614PE/MT621OE**

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**Course Objectives:**

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

**Course Outcomes:**

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

**UNIT- I**

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists-Operations- Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

**UNIT- II**

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.



**UNIT- III**

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.

**UNIT- IV**

Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

**UNIT- V**

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees.

Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

**TEXT BOOKS:**

1. Fundamentals of Data structures in C, 2<sup>nd</sup> Edition, E.Horowitz, S.Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.

**REFERENCE BOOKS:**

1. Data structures: A Pseudocode Approach with C, 2<sup>nd</sup> edition, R. F. Gilberg And B.A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2<sup>nd</sup> edition, M.A.Weiss, Pearson.
3. Data Structures using C, A. M. Tanenbaum, Y. Langsam, M.J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2<sup>nd</sup> edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2<sup>nd</sup> Edition, Narsimha Karumanchi, and Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipschutz, Schaum's Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2<sup>nd</sup> edition, Pearson..
9. Data Structures using C &C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2<sup>nd</sup> edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

**B.TECH. AUTOMOBILE ENGINEERING  
ARTIFICIAL NEURAL NETWORKS  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: MT622OE**

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**Course Objectives:**

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

**Course Outcomes:** By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

**UNIT - I**

**Introduction:** A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

**Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

**UNIT - II**

**Single Layer Perceptron:** Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

**Multilayer Perceptron:** Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

**UNIT - III**

**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

**UNIT - IV**

**Self-Organization Maps (SOM):** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

**UNIT - V**

**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

**Hopfield Models –** Hopfield Models, Computer Experiment

**TEXT BOOKS:**

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

**B.TECH. AUTOMOBILE ENGINEERING  
INTRODUCTION TO MECHATRONICS  
(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: AM831OE**

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**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**

**Introduction:** Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**Signal Conditioning :** Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registers, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resettable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

### **UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview :** 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C ( LED Blinking , Voltage measurement using ADC).

### **UNIT – IV**

**Programmable Logic Controllers :** Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

### **UNIT – V**

**Programmable Motion Controllers :** Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

### **TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

### **REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. “Designing Intelligent Machines”. open University, London.

**B.TECH. AUTOMOBILE ENGINEERING  
MICROPROCESSORS AND MICROCONTROLLERS  
(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: AM832OE**

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**Course Objectives:**

- To develop an understanding of the operations of microprocessors and micro controllers; machine language programming and interfacing techniques.

**Course Outcomes:**

- Understands the internal architecture and organization of 8086, 8051 and ARM processors/controllers.
- Understands the interfacing techniques to 8086 and 8051 and can develop assembly language programming to design microprocessor/ micro controller based systems.

**UNIT - I**

**8086 Architecture:** 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

**Instruction Set and Assembly Language Programming of 8086:** Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

**UNIT - II**

**Introduction to Microcontrollers:** Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

**8051 Real Time Control:** Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

**UNIT – III**

**I/O And Memory Interface:** LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

**Serial Communication and Bus Interface:** Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

**UNIT – IV**

**ARM Architecture:** ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions,

Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

#### **UNIT – V**

**Advanced ARM Processors:** Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

#### **TEXT BOOKS:**

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2<sup>nd</sup> Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3<sup>rd</sup> Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

#### **REFERENCE BOOKS:**

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2<sup>nd</sup> Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson, 2009.

**B.TECH. BIOMEDICAL ENGINEERING**  
**RELIABILITY ENGINEERING**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: BM511OE**

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**Prerequisite:** Mathematics III

**Course Objectives:**

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

**Course Outcomes:** After completion of this course, the student will be able to

- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irreparable systems

**UNIT – I**

**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

**Definition of Reliability:** Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

**UNIT – II**

**Network Modeling and Evaluation Of Simple Systems:** Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.

**Network Modeling and Evaluation of Complex systems:** Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

**UNIT – III**

**Time Dependent Probability:** Basic concepts- Reliability function  $f(t)$ .  $F(t)$ ,  $R(t)$  and  $h(t)$  - Relationship between these functions.



**Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

#### **UNIT – IV**

**Discrete Markov Chains:** Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

**Continuous Markov Processes:** Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

#### **UNIT – V**

**Frequency and Duration Techniques:** Frequency and duration concepts, application to multi state problems, Frequency balance approach.

**Approximate System Reliability Evaluation:** Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

#### **TEXT BOOKS:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

#### **REFERENCE BOOK:**

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993.

**B.TECH. BIOMEDICAL ENGINEERING**  
**MEDICAL ELECTRONICS**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: BM621OE**

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**Pre-requisites:** Nil.

**UNIT - I**

**Action Potential and Transducers:** Electrical activity in cells, tissues, muscles and nervous systems -transducers-types and characteristics

Physiological transducers – pressure transducers-transducers for body temperature measurement – Pulse sensors-respiratory sensors.

**UNIT - II**

**Biosignal Acquisition:** Physiological signal amplifiers-isolation amplifiers-medical pre-amplifier design-bridge amplifiers-line driving amplifier-current amplifier – chopper amplifier-biosignal analysis - signal recovery and data acquisition-drift compensation in operational amplifiers-pattern recognition-physiological assist devices.

**UNIT - III**

**Biopotential Recorders:** Characteristics of recoding system - electrocardiography (ECG) – electro encephalography (EEG) - electromyography (EMG) - electroretinography (ERG) - electrooculography (EOG) – recorders with high accuracy –recorders for OFF line analysis.

**UNIT - IV**

**Specialized Medical Equipment:** Digital thermometer-audio meter –X-ray machines-radiography and fluoroscopy - angiography – elements of bio-telemetry system-design of bio-telemetry system-radio telemetry system-pace makers-Heart lung machine-Dialysis machine.

**UNIT - V**

**Advanced Biomedical Instrumentation:** Computers in medicine - lasers in medicine – basic principles of endoscopes- nuclear imaging techniques - computer tomography (CT) Scanning –Ultrasonic imaging system-construction propagation and delay – magnetic resonance imaging (MRI).

**TEXT BOOKS:**

1. Biomedical Instrumentation and Measurements-L. Cromwell, F.J. Weibel land E. A. Pfeiffer.
2. Biomedical Instrumentation- M. Arumugam - Anuradha Publications.
3. Handbook of Biomedical Instruments- R.S. Khandpur.

**B.TECH. BIOMEDICAL ENGINEERING  
TELEMETRY AND TELECONTROL  
(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: BM831OE**

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**Pre-requisites:** Nil.

**Course Objective:** To make students understand the application of telemetry techniques to Instrumentation.

**Course Outcome:** Upon completion of this course students will appreciate the application of different telemetry systems and control to any process.

**UNIT – I**

**Telemetry Principles:** Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency.

**Symbols and Codes:** Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

**UNIT – II**

**Frequency & Time Division Multiplexed Systems:** FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.

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.

**Modern Telemetry:** Zigbee, Ethernet.

**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.

**TEXT BOOKS:**

1. Telemetry Principles – D. Patranabis, TMH

2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991

**REFERENCE BOOKS:**

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.
2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.
3. Data Communication and Teleprocessing System – by Housley T., PH Intl., Englewood Cliffs, New Jersey, 1987.

**B.TECH. BIOMEDICAL ENGINEERING**  
**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: BM832OE**

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**Course Objectives:**

- To introduce important system concepts such as Electromagnetic interference and Electromagnetic compatibility (EMI & EMC).
- To familiarize with unavoidable and naturally happening sources of EMI and problems to ensure EMC.
- To study various techniques to reduce EMI from systems and to improve EMC of electronic systems.

**Course Outcomes:** Upon completion of this course, the student will be able to

- Gain basic knowledge of problems associated with EMI and EMC from electronic circuits and systems.
- Analyze various sources of EMI and various possibilities to provide EMC.
- Understand and analyze possible EMI prevention techniques such as grounding, shielding, filtering, and use of proper coupling mechanisms to improve compatibility of electronic circuits and systems in a given electromagnetic environment.

**UNIT – I**

**Sources of EMI:** Definition of EMI and EMC, Classification, Natural and Man-Made EMI Sources, Switching Transients, Electrostatic Discharge, Nuclear Electromagnetic Pulse and High Power Electromagnetics.

**EMI/EMC Standards:** Introduction, Standards for EMI/EMC – MIL –STD 461/462 – IEEE/ANSI Standards – CISPR/IEC, Standards – FCC Regulations.

**UNIT - II**

**EMI Coupling Modes:** Penetration: Introduction, Shielding Theory - Shielding Effectiveness, The Circuit Approach, The Wave Approach, Aperture Theory, Calculation of Effectiveness of a Conducting Box with an Aperture, Introduction to Propagation and Cross Talk – Introduction, Basic Principles, Determination of EM Field from Transmission Lines.

**UNIT - III**

**EMI Controlling Techniques - I:** Grounding, Principles and Practice of Earthing, Precautions in Earthing, Measurements of Ground Resistance, System Grounding for EMC, Cable Shielding Grounding.

Shielding, Theory and Effectiveness, Materials, Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Effectiveness Measurements, Electrical Bonding.

#### **UNIT – IV**

**EMI Controlling Techniques - II:** Characteristics and Types of Filters – Impedance Mismatch, Lumped Element Low-Pass, High- Pass, Band-Pass and Band-Reject Filters, Power Line Filter Design - Common Mode, Differential Mode, Combined CM and DM Filters, Design Example.

EMC Gaskets – Knitted Wire-Mesh Gaskets, Wire-Screen Gaskets, Oriented Wire Mesh, Conductive Elastomer, Transparent Conductive Windows, Conductive Adhesive, Conductive Grease, Conductive Coatings, Isolation Transformers, Opto-Isolators.

#### **UNIT - V**

**EMI Measurements:** Introduction to Open Area Test Site Measurements – Measurement Precautions – Open Area Test Site – Terrain Roughness – NSA – Measurement of Test Site Imperfections – Antenna Factor Measurement – Measurement Errors.

Radiated Interference Measurements – Anechoic Chamber – TEM Cell – Reverberating Chamber – Ghz TEM Cell – Comparison of Test Facilities – Measurement Uncertainties  
Conducted Interference Measurements – Characterization – Conducted EM Noise on Power Supply Lines – Conducted EMI from Equipment – Immunity – Detectors and Measurement – Pulsed EMI Immunity – Electrostatic Discharge.

#### **TEXT BOOKS:**

1. Engineering Electromagnetic Compatibility – V. Prasad Kodali – 2/e – IEEE Press – Wiley India Pvt. Ltd – 2001.

#### **REFERENCES:**

1. Introduction to Electromagnetic Compatibility – Clayton R. Paul – John Wiley & Sons, 1992.
2. Electromagnetic Compatibility of Integrated Circuits – Techniques for Low Emission and Susceptibility – Edited by Sonia Ben Dhia, Mohamed Ramdani and Etienne Sicard – Springer, 2006.
3. EMI reduction in Electronic Systems – Mills – J.P – Prentice Hall Inc.
4. Noise Reduction in Electronic Systems – Henry W. Ott, 2<sup>nd</sup> Edition, Wiley Interscience, 1988.

**B.TECH. CIVIL ENGINEERING**  
**DISASTER MANAGEMENT**  
**(Open Elective - I)**

**B.Tech. III Year I Sem**  
**Course Code: CE511OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** The subject provide different disasters, tools and methods for disaster management

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

**UNIT - II**

**Disaster Management Mechanism:** Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

**UNIT - III**

**Capacity Building:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

**UNIT - IV**

**Coping with Disaster:** Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

**UNIT - V**

**Planning for disaster management:** Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

**TEXT BOOKS:**

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (<http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf>)



**B.TECH. CIVIL ENGINEERING  
REMOTE SENSING AND GIS  
(Open Elective - II)**

**B.Tech.IV Year II Sem**  
**Course Code: CE621OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre Requisites:** Surveying

**Course Objectives:** This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

**Course Outcomes:** At the end of the course, the student will be able to:

- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

**UNIT – I**

**Introduction to Photogrammetry:** Principles & types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

**UNIT – II**

**Remote Sensing:** Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

**UNIT – III**

**Geographic Information Systems:** Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters- Commonly used Map Projections - Projected coordinate Systems

#### **UNIT – IV**

**Vector Data Model:** Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

#### **UNIT – V**

**Raster Data Model:** Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

**Data Input:** Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

#### **TEXT BOOKS:**

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

#### **REFERENCES:**

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yongg, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

**B.TECH CIVIL ENGINEERING  
GEOINFORMATICS  
(Open Elective - II)**

**B.Tech. III Year II Sem**  
**Course Code: CE622OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:**

- To introduce the concepts of remote sensing, satellite image characteristics and its components.
- To expose the various remote sensing platforms and sensors and to introduce the concepts of GIS, GPS and GNSS.

**Course Outcomes:** At the end of the course the student will be able to understand

- The characteristics of Aerial photographic images ,Remote sensing satellites and Applications of remote sensing.
- The GIS and its Data models.
- The Global Navigation Satellite System.

**UNIT – I**

Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation, Introduction to Digital Photogrammetry.

**UNIT - II**

Remote Sensing: Physics of remote sensing, Remote sensing satellites, and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

**UNIT – III**

Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing

**UNIT - IV**

Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications

**UNIT - V**

Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Datum, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications

**TEXT BOOKS:**

1. Remote Sensing & GIS , BS Publications
2. Higher Surveying by A M Chandra New Age International Publisher
3. Remote Sensing & GIS by B. Bhatta Oxford University Press
4. Introduction to GPS by A. E Rabbany Library of congress cataloging in Publication data

**REFERENCES:**

1. T M Lillesand et al: Remote Sensing & Image Interpretation
2. Higher Surveying by B C Punmia Ashok kr. Jain Laxmi Publications
3. N K Agarwal : Essentials of GPS , Spatial Networks: Hyderabad

**B.TECH. CIVIL ENGINEERING  
INTELLECTUAL PROPERTY RIGHTS  
(Open Elective - II)**

**B.Tech. III Year II Sem**  
**Course Code: CE623OE**

**L T/P/D C**  
**3 0/0/0 3**

**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

**B.TECH CIVIL ENGINEERING**  
**ENVIRONMENTAL IMPACT ASSESSMENT**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: CE831OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre Requisites:** Environmental Engineering

**Course Objectives:** This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

**Course Outcomes:**

- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Identify and incorporate mitigation measures.

**UNIT – I**

Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.

E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

**UNIT- II**

Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.

**UNIT- III**

Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures.

**UNIT – IV**

Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

**UNIT - V**

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

**TEXT BOOKS:**

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

**REFERENCES:**

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

**B.TECH. CIVIL ENGINEERING**  
**OPTIMIZATION TECHNIQUES IN ENGINEERING**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: CE832OE**

**L T/P/D C**  
**3 0/0/0 3**

**Prerequisites:** Operations Research

**Course Objectives:** After doing this subject student should know

- The various optimization techniques for single variable optimization problem
- Direct search methods and Gradient methods for multi variable un constraint Optimization problems
- Formulate a Geometric Programming model and solve it by using Arithmetic Geometric in equality theorem
- Simulate the system
- Thorough of state of art optimization techniques like Genetic Algorithms, simulated Annealing

**Course Outcomes:** For a given system, as per customer requirement it is required to

- Formulate optimization problem.
- Solve the problem by using a appropriate optimization techniques.

**UNIT - I**

**Single Variable Non-Linear Unconstrained Optimization:** Elimination methods: Uni-Model function-its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

**UNIT - II**

**Multi variable non-linear unconstrained optimization:** Direct search methods – Univariant method, Pattern search methods – Powell’s, Hook - Jeeves, Rosen brock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

**UNIT - III**

**Linear Programming** – Formulation, Simplex method, & artificial variable optimization techniques: Big M & Two phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition and deletion of variables, constraints.

Simulation – Introduction – Types- steps – applications: inventory & queuing – Advantages and disadvantages



#### **UNIT - IV**

**Integer Programming-** Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

**Stochastic Programming:** Basic concepts of probability theory, random variables-distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

#### **UNIT - V**

**Geometric Programming:** Polynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P ( $\leq$  type only)

**Non Traditional Optimization Algorithms:** Genetics Algorithm-Working Principles, Similarities, and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO)(very brief)

#### **TEXT BOOKS:**

1. Optimization theory & Applications / S. S. Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

#### **REFERENCES:**

1. Operations Research by S. D. Sharma Kedarnath & Ramnath Publisher
2. Operation Research by Hamdy A Taha Pearson Educations
3. Optimization in operations research by Ronald L. Rardin Pearson Publisher
4. Optimization Techniques by Benugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M. C. Joshi, K. M. Moudgalya Narosa Publications

**B.TECH. CIVIL ENGINEERING**  
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**  
**(Open Elective - III)**

**B.Tech. IV Year III Sem**  
**Course Code: CE833OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**

Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.

Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**

Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**

Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**

Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**

Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**Text Books:**

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V.Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**  
**DISASTER MANAGEMENT**  
**(Open Elective - I)**

**B.Tech. III Year I Sem**  
**Course Code: CE511OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** The subject provide different disasters, tools and methods for disaster management

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

**UNIT - II**

**Disaster Management Mechanism:** Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

**UNIT - III**

**Capacity Building:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

**UNIT - IV**

**Coping with Disaster:** Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

**UNIT - V**

**Planning for disaster management:** Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

**TEXT BOOKS:**

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (<http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf>)

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**  
**ENVIRONMENTAL IMPACT ASSESSMENT**  
**(Open Elective - II)**

**B.Tech.III Year II Sem**  
**Course Code: CN621OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre Requisites:** Environmental Engineering

**Course Objectives:** This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

**Course Outcomes:**

- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Identify and incorporate mitigation measures.

**UNIT – I**

Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.

E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

**UNIT- II**

Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.

**UNIT- III**

Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures.

**UNIT – IV**

Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

## **UNIT - V**

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

### **TEXT BOOKS:**

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

### **REFERENCES:**

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**  
**INTELLECTUAL PROPERTY RIGHTS**  
**(Open Elective - II)**

**B.Tech.III Year II Sem**  
**Course Code: CE623OE**

**L T/P/D C**  
**3 0/0/0 3**

**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,



**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**  
**REMOTE SENSING & GIS**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: CN831OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre Requisites:** Surveying

**Course Objectives:** This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

**Course Outcomes:** At the end of the course, the student will be able to:

- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

**UNIT – I**

**Introduction to Photogrammetry:** Principles & types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

**UNIT – II**

**Remote Sensing:** Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

**UNIT – III**

**Geographic Information Systems:** Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters- Commonly used Map Projections - Projected coordinate Systems

#### **UNIT – IV**

**Vector Data Model:** Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

#### **UNIT – V**

**Raster Data Model:** Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

**Data Input:** Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

#### **TEXT BOOKS:**

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

#### **REFERENCES:**

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yongg, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING  
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES  
(Open Elective – III)**

**B.Tech. III Year II Sem.**  
**Course Code: CE833OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**

Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.

Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**

Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**

Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**

Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**

Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
OPERATING SYSTEMS  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: CS511OE**

**L T P C**  
**3 0 0 3**

**Course Objectives:**

- To understand the OS role in the overall computer system
- To study the operations performed by OS as a resource manager
- To understand the scheduling policies of OS
- To understand the different memory management techniques
- To understand process concurrency and synchronization
- To understand the concepts of input/output, storage and file management
- To understand the goals and principles of protection
- Introduce system call interface for file and process management
- To study different OS and compare their features.

**Course Outcomes:**

- Apply optimization techniques for the improvement of system performance.
- Ability to design and solve synchronization problems.
- Learn about minimization of turnaround time, waiting time and response time and also maximization of throughput by keeping CPU as busy as possible.
- Ability to change access controls to protect files.
- Ability to compare the different operating systems.

**UNIT - I**

Overview-Introduction-Operating system objectives, User view, System view, Operating system definition ,Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.

Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

**UNIT - II**

Process and CPU Scheduling - Process concepts-The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(),exec(),wait(),exit(), Interprocess communication-ordinary pipes and named pipes in Unix.

Process Scheduling-Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Linux scheduling and Windows scheduling.

Process Synchronization, Background, The Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization in Linux and Windows.

### **UNIT - III**

Memory Management and Virtual Memory – Memory Management Strategies- Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table, IA-32 Segmentation, IA-32 Paging.

Virtual Memory Management-Background, Demand Paging, Copy-on-Write, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Virtual memory in Windows..

### **UNIT - IV**

Storage Management-File System- Concept of a File, System calls for file operations - open (), read (), write (), close (), seek (), unlink (), Access methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

File System Implementation - File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance.

Mass Storage Structure – Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management

### **UNIT - V**

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Protection – System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

### **TEXT BOOKS:**

1. Operating System Concepts , Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2016 India Edition
2. Operating Systems – Internals and Design Principles, W. Stallings, 7th Edition, Pearson.

### **REFERENCE BOOKS:**

1. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2. Operating Systems A concept-based Approach, 2nd Edition, D.M. Dhamdhare, TMH.
3. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.
4. An Introduction to Operating Systems, P.C.P. Bhatt, PHI.
5. Principles of Operating systems, Naresh Chauhan, Oxford University Press.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
DATABASE MANAGEMENT SYSTEMS  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: CS512OE**

**L T P C**  
**3 0 0 3**

**Course Objectives:**

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

**Course Outcomes:**

- Demonstrate the basic elements of a relational database management system.
- Ability to identify the data models for relevant problems.
- Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.
- Apply normalization for the development of application software.

**UNIT - I**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Data base design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT - II**

**Relational Algebra and Calculus:** Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases..

### **UNIT - III**

**Schema Refinement and Normal Forms:** Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

### **UNIT - IV**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

### **UNIT - V**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

Tree-Structured Indexing: Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

**Hash- Based Indexing:** Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

### **TEXT BOOKS:**

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3<sup>rd</sup> Edition. (**Part of UNIT-I, UNIT-II, UNIT-III, UNIT-V**)
2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited 1, 6<sup>th</sup> edition.( **Part of UNIT-I, UNIT-IV**)

### **REFERENCE BOOKS:**

1. Database Systems, 6<sup>th</sup> edition, R Elmasri, Shamkant B.Navathe, Pearson Education.
2. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning.
3. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition.
4. Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.
5. Introduction to Database Systems, C. J. Date, Pearson Education.



**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
JAVA PROGRAMMING  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: CS621OE**

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**Course Objectives:**

- To understand object oriented programming concepts, and apply them in problem solving.
- To learn the basics of java Console and GUI based programming.

**Course Outcomes:**

- Understanding of OOP concepts and basics of java programming (Console and GUI based).
- The skills to apply OOP and Java programming in problem solving.
- Should have the ability to extend his/her knowledge of Java programming further on his/her own.

**UNIT- I**

**OOP concepts** – Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms

**Java programming** - History of Java, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow - block scope, conditional statements, loops, break and continue statements, simple java stand alone programs, arrays, console input and output, formatting output, constructors, methods, parameter passing, static fields and methods, access control, this reference, overloading methods and constructors, recursion, garbage collection, building strings, exploring string class.

**UNIT- II**

**Inheritance** - Inheritance hierarchies, super and sub classes, Member access rules, super keyword, preventing inheritance: final classes and methods, the Object class and its methods

**Polymorphism**- dynamic binding, method overriding, abstract classes and methods.

**Interfaces** – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface.

**Inner classes** – Uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

**Packages**-Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

### UNIT- III

**Exception handling** – Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes.

**Multithreading** - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, producer consumer pattern.

### UNIT- IV

**Collection Framework in Java** – Introduction to Java Collections, Overview of Java Collection frame work, Generics, Commonly used Collection classes– Array List, Vector, Hash table, Stack, Enumeration, Iterator, String Tokenizer, Random, Scanner, calendar and Properties

**Files** – streams- byte streams, character streams, text Input/output, binary input/output, random access file operations, File management using File class.

**Connecting to Database** - JDBC Type 1 to 4 drivers, connecting to a database, querying a database and processing the results, updating data with JDBC.

### UNIT- V

**GUI Programming with Java** - The AWT class hierarchy, Introduction to Swing, Swing vs. AWT, Hierarchy for Swing components, Containers – JFrame, JApplet, JDialog, JPanel, Overview of some swing components- JButton, JLabel, JTextField, JTextArea, simple swing applications, Layout management - Layout manager types – border, grid and flow

**Event handling** - Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation event model, Examples: handling a button click, handling mouse events, Adapter classes.

**Applets** – Inheritance hierarchy for applets, differences between applets and applications, life cycle of an applet, passing parameters to applets, applet security issues.

### TEXT BOOK:

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.

### REFERENCE BOOKS:

1. Java for Programmers, P.J.Deitel and H.M.Deitel, Pearson education (OR) Java: How to Program P.J.Deitel and H.M.Deitel, PHI.
2. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
3. Thinking in Java, Bruce Eckel, Pearson Education
4. Programming in Java, S.Malhotra and S.Choudhary, Oxford Univ. Press.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
SOFTWARE TESTING METHODOLOGIES  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: CS622OE**

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| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Objectives:**

To understand the software testing methodologies such as flow graphs and path testing, transaction flows testing, data flow testing, domain testing and logic base testing.

**Course Outcomes:**

- Ability to apply the process of testing and various methodologies in testing for developed software.
- Ability to write test cases for given software to test it before delivery to the customer.

**UNIT - I**

Introduction:- Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.

Flow graphs and Path testing:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

**UNIT - II**

Transaction Flow Testing:-transaction flows, transaction flow testing techniques.

Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

**UNIT - III**

Domain Testing:-domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

**UNIT-IV**

Paths, Path products and Regular expressions:- path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

**UNIT - V**

State, State Graphs and Transition testing:- state graphs, good & bad state graphs, state testing, Testability tips.

Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

**TEXT BOOKS:**

1. Software Testing techniques – Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech.

**REFERENCE BOOKS:**

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing,3<sup>rd</sup> edition,P.C. Jorgensen, Aurbach Publications (Dist.by SPD).
3. Software Testing, N.Chauhan, Oxford University Press.
4. Introduction to Software Testing, P.Ammann&J.Offutt, Cambridge Univ.Press.
5. Effective methods of Software Testing, Perry, John Wiley, 2<sup>nd</sup> Edition, 1999.
6. Software Testing Concepts and Tools, P.Nageswara Rao, dreamtech Press.
7. Software Testing, M.G.Limaye, TMH.
8. Software Testing, S.Desikan, G.Ramesh, Pearson.
9. Foundations of Software Testing, D.Graham & Others, Cengage Learning.
10. Foundations of Software Testing, A.P.Mathur, Pearson.

**B.TECH COMPUTER SCIENCE AND ENGINEERING / B.TECH INFORMATION  
TECHNOLOGY  
CYBER SECURITY  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: CS623OE**

**L T P C**  
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**UNIT- I**

**Introduction to Cybercrime:** Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT - II**

**Cyber Offenses: How Criminals Plan Them:** Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

**UNIT - III**

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

**UNIT IV**

**Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT V**

**Cyber Security:** Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**TEXT BOOK:**

1. **Cyber Security:** *Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Nina Godbole and Sunil Belapure, Wiley INDIA.

**REFERENCE BOOK:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press  
T&F Group

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
LINUX PROGRAMMING  
(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: CS831OE**

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**Course Objectives:**

- To understand and make effective use of Linux utilities and Shell scripting language (bash) to solve Problems.
- To implement in C some standard Linux utilities such as ls, mv, cp etc. using system calls.
- To develop the skills necessary for systems programming including file system programming, process and signal management, and interprocess communication.
- To develop the basic skills required to write network programs using Sockets.

**Course Outcomes:**

- Work confidently in Linux environment.
- Work with shell script to automate different tasks as Linux administration.

**UNIT- I**

**Linux Utilities** - File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities.

Sed-Scripts, Operation, Addresses, Commands, Applications, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.

**Shell programming with Bourne again shell (bash)** - Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

**UNIT- II**

**Files and Directories** - File Concept, File types, File System Structure, file metadata-Inodes, kernel support for files, system calls for file I/O operations- open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links – symlink, link, unlink. **Directories** - Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT- III**

**Process** – Process concept, Layout of a C program image in main memory, Process environment-environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process, system call interface for process management-fork, vfork, exit, wait, waitpid, exec family, Process Groups, Sessions and Controlling Terminal, Differences between threads and processes.

**Signals** – Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions.

**UNIT- IV**

**Interprocess Communication** - Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pipes-creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs (Named pipes), differences between unnamed and named pipes, popen and pclose library functions. **Message Queues** - Kernel support for messages, APIs for message queues, client/server example. **Semaphores** - Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

**UNIT- V**

**Shared Memory** - Kernel support for shared memory, APIs for shared memory, shared memory example. **Sockets** - Introduction to Berkeley Sockets, IPC over a network, Client-Server model, Socket address structures (Unix domain and Internet domain), Socket system calls for connection oriented protocol and connectionless protocol, example-client/server programs-Single Server-Client connection, Multiple simultaneous clients, Socket options-setsockopt andfcntl system calls, Comparison of IPC mechanisms.

**TEXT BOOKS:**

1. Unix System Programming using C++, T. Chan, PHI.
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Unix Network Programming, W. R. Stevens, PHI.

**REFERENCE BOOKS:**

1. Beginning Linux Programming, 4<sup>th</sup> Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
2. Unix for programmers and users, 3<sup>rd</sup> Edition, Graham Glass, King Ables, Pearson.
3. System Programming with C and Unix, A. Hoover, Pearson.
4. Unix System Programming, Communication, Concurrency and Threads, K. A. Robbins and S. Robbins, Pearson Education.
5. Unix shell Programming, S. G. Kochan and P. Wood, 3<sup>rd</sup> edition, Pearson Education.
6. Shell Scripting, S. Parker, Wiley India Pvt. Ltd.



7. Advanced Programming in the Unix Environment, 2<sup>nd</sup> edition, W. R. Stevens and S. A. Rago, Pearson Education.
8. Unix and Shell programming, B. A. Forouzan and R. F. Gilberg, Cengage Learning.
9. Linux System Programming, Robert Love, O'Reilly, SPD.
10. C Programming Language, Kernighan and Ritchie, PHI

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
R PROGRAMMING  
(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: CS832OE**

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**Course Objectives:**

- Understanding and being able to use basic programming concepts
- Automate data analysis
- Working collaboratively and openly on code
- Knowing how to generate dynamic documents
- Being able to use a continuous test-driven development approach

**Course Outcomes:**

- be able to use and program in the programming language R
- be able to use R to solve statistical problems
- be able to implement and describe Monte Carlo the technology
- be able to minimize and maximize functions using R

**UNIT – I**

**Introduction:** Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

**UNIT – II**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

**Vectors:** Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

**UNIT – III**

**Lists:** Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

**UNIT - IV**

FACTORS AND TABLES, Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

**UNIT - V**

**OBJECT-ORIENTED PROGRAMMING:** S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

**TEXT BOOKS:**

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth singh, Vivek Mourya, Cengage Learning India.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION  
TECHNOLOGY  
PHP PROGRAMMING  
(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: CS833OE**

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**Course Objectives:**

- Gain the PHP programming skills needed to successfully build interactive, data-driven sites
- Use the MVC pattern to organize code
- Test and debug a PHP application
- Work with form data
- Use cookies and sessions
- Work with regular expressions, handle exceptions, and validate data

**Course Outcomes:**

- Be able to develop a form containing several fields and be able to process the data provided on the form by a user in a PHP-based script.
- Understand basic PHP syntax for variable use and standard language constructs, such as conditionals and loops.
- Understand the syntax and use of PHP object-oriented classes.
- Understand the syntax and functions available to deal with file processing for files on the server as well as processing web URLs.
- Understand the paradigm for dealing with form-based data, both from the syntax of HTML forms, and how they are accessed inside a PHP-based script.

**Unit - I:**

**INTRODUCTION TO PHP:** History of PHP, Apache Web Server, MySQL and Open Source, Relationship between Apache, MySQL and PHP (AMP Module), PHP configuration in IIS, Apache Web server

**BASICS OF PHP:** PHP structure and syntax, Creating the PHP pages, Rules of PHP syntax, Integrating HTML with PHP, Constants, Variables : static and global variable, Conditional Structure & Looping, PHP Operators, Arrays, for each constructs, User defined function, argument function, Variable function, Return Function, default argument, variable length argument.

**Unit - II:**

**WORKING WITH FUNCTIONS:** Variable Function, String Function, Math Function, Date Function, Array Function, and File Function. User defined function, Systems defined function, Parameterized function, Non parameterized function, Dynamic parameter in function, Variable scope, Passing Argument in function, Static function.

**Unit - III:**

**WORKING WITH DATA:** FORM element, INPUT elements, Processing the form, User Input, Adding items, Validating the user input, Passing variables between pages. Files, Creating and deleting file, Reading and writing file, Working with file, Creating and deleting folder, Working with regular Expression Basic regular expression, Matching patterns, Finding match, Replace match,

**Unit - IV:**

**ERROR HANDLING:** Error types in PHP, Generating PHP errors, Exceptions, Parse errors, State Management: - Cookies Session, Destroying cookies and session Http management, Sent mail

**Images with PHP:** Working with GD Library, File types with GD and PHP, Compiling PHP with GD, Creating the image table, uploading the image.

**Unit - V:**

**INTRODUCTION TO MYSQL:** MySQL structure and syntax, Types of MySQL tables and storages engines, MySQL commands, Integration of PHP with MySQL, Connection to the MySQL server, Working with PHP and arrays of data, Referencing two tables, Joining two tables.

**WORKING WITH DATABASE:** Creating a table, manipulating the table, editing the database, inserting a record, deleting a record, editing data

**Understand process of executing a PHP-based script on a webserver.**

**TEXT BOOKS:**

1. **Beginning PHP, Apache, MySQL Web Development** - Elizabeth Naramore, Jason Gerner, Yann Le, Scouarnec, Jeremy Stolz, Michael K. Glass, Gary Mailer - By Wrox Publication.
2. **PHP, MySQL and Apache** - Julie C. Melone By Pearson Education

**REFERENCE BOOKS:**

1. **Beginning PHP 5.3**, by Matt Doyle - By Wrox Publication
2. **PHP and MySQL Bible** – Tim Converse and Joyce Park with Clark Morgam By Wiley INDIA

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
PRINCIPLES OF ELECTRONIC COMMUNICATIONS  
(OPEN ELECTIVE - I)**

**B.Tech. III Year I Sem.**  
**Course Code: EC511OE**

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**Course Objectives:** The objective of this subject is to:

- Introduce the students to modulation and various analog and digital modulation schemes.
- They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts.

**Course Outcomes:** By completing this subject, the student can

- Work on various types of modulations.
- Should be able to use these communication modules in implementation.
- Will have a basic understanding of various wireless and cellular, mobile and telephone communication systems.

**UNIT - I**

**Introduction:** Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

**UNIT - II**

**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

**UNIT - III**

**Telecommunication Systems:** Telephones Telephone system, Paging systems, Internet Telephony.

**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

**UNIT - IV**

**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT - V**

**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.

**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**Text Books:**

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL EDUCATION, 1999

**Reference Books:**

1. Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
3. Introduction to data communications and networking, Wayne Tomasi, Pearson Education, 2005.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: EC621OE**

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**Course Objectives:**

- To understand the concept of computer communication.
- To learn about the networking concept, layered protocols.
- To understand various communications concepts.
- To get the knowledge of various networking equipment.

**Course Outcomes:**

- The student can get the knowledge of networking of computers, data transmission between computers.
- Will have the exposure about the various communication concepts.
- Will get awareness about the structure and equipment of computer network structures.

**UNIT - I**

**Overview of Computer Communications and Networking:** Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

**UNIT - II**

**Essential Terms and Concepts:** Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

**UNIT - III**

**Analog and Digital Communication Concepts:** Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction, Digital Carrier Systems.

**UNIT - IV**

**Physical and data link layer Concepts:** The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.



**UNIT - V**

**Network Hardware Components:** Introduction to Connectors, Transreceivers and media convertors, repeaters, network interface cards and PC cards, bridges, switches, switches Vs Routers.

**TEXT BOOKS:**

1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.
2. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition MC GRAW HILL EDUCATION, 2006.

**REFERENCE BOOKS:**

1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.
2. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3<sup>rd</sup> Edition, Pearson Education.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
ELECTRONIC MEASURING INSTRUMENTS  
(OPEN ELECTIVE - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EC831OE**

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**Note: No detailed mathematical treatment is required.**

**Course Objectives:**

- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:** On completion of this course student can be able to

- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

**UNIT - I**

**Block Schematics of Measuring Systems and Performance Metrics:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag.

**UNIT - II**

**Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, and Specifications.

**UNIT - III**

**Measuring Instruments:** DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments. CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes.

**UNIT - IV**

**Recorders:** X-Y Plotter, Curve tracer, Galvanometric Recorders, Servo transducers, pen driving mechanisms, Magnetic Recording, Magnetic recording techniques.

**UNIT - V**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

**TEXT BOOKS:**

1. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2<sup>nd</sup> Edition 2004.

**REFERENCES:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbins, W.D. Cooper: PHI 5<sup>th</sup> Edition 2003.
3. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**  
**SCRIPTING LANGUAGES**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EM511OE**

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**Course Objectives:** The goal of the course is to study:

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment.
- Usage of scripting languages in IC design flow.

**Course Outcomes:**

Upon learning the course, the student will have the:

- Ability to create and run scripts using PERL/TCL/Python in IC design flow.
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.

**UNIT –I:**

**Linux Basics:**

Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

**UNIT –II :**

**Linux Networking:**

Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

**UNIT –III :**

**Perl Scripting:**

Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

**UNIT –IV:**

**Tcl / Tk Scripting:**

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Eval, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

**UNIT –V :**

**Python Scripting:**

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

**TEXT BOOKS:**

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
3. Teach Yourself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

**REFERENCE BOOKS:**

1. Learning Python – 2<sup>nd</sup> Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3<sup>rd</sup> Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4<sup>th</sup> Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Python Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3<sup>rd</sup> Edition, O'Reilly, 2000. (ISBN 0596000278)

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**  
**SOFT COMPUTING TECHNIQUES**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EM621OE**

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**Prerequisite:** Nil.

**Course Objectives:** This course makes the students to Understand

- Fundamentals of Neural Networks & Feed Forward Networks.
- Associative Memories & ART Neural Networks.
- Fuzzy Logic & Systems.
- Genetic Algorithms and Hybrid Systems.

**Course Outcomes:** On completion of this course the students will be able to

- Identify and employ suitable soft computing techniques in classification and optimization problems.
- Design hybrid systems to suit a given real – life problem.

**UNIT –I:**

**Fundamentals of Neural Networks & Feed Forward Networks:**

Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network (BPN), The Solution, Back propagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

**UNIT –II:**

**Associative Memories & ART Neural Networks:**

Basic concepts of Linear Associator, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks(HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

**UNIT –III:**

**Fuzzy Logic & Systems:**

Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller.

**UNIT –IV:**

**Genetic Algorithms:**

Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

**UNIT –V:**

**Hybrid Systems:**

Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation  
Dept. of ECE, JNTUHCEH M.Tech. (SSP) (FT) w.e.f. 2015-16 56 Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

**TEXT BOOKS:**

1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, July 2011, PHI, New Delhi.
3. Genetic Algorithms by David E. Goldberg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Systems- Kosko.B., PHI, Delhi,1994.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**  
**DATA ANALYTICS**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EM831OE**

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**Prerequisite:** Nil

**Course Objectives:** The student should be made to :

- Be exposed to conceptual frame work of big data.
- Understand different techniques of Data Analysis.
- Be familiar with concepts of data streams.
- Be exposed to item sets, Clustering, frame works and Visualization.

**Course Outcomes:** Upon completion of this course the students will be able to

- Understand Big data fundamentals.
- Learn various Data Analysis Techniques
- Implement various Data streams.
- Understand item sets, Clustering, frame works & Visualizations.

#### **UNIT – I**

**Introduction to Big Data:** Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability , analytic process and tools , Analysis vs Reporting – Modern data analytic tools, stastical concepts : Sampling distributions, resampling , statistical inference, prediction error.

#### **UNIT – II**

**Data Analysis:** Regression modeling , Multivariate analysis, Bayesian modeling , inference and Bayesian networks , Support vector and Kernel methods, Analysis of time series : Linear systems analysis , nonlinear dynamics – Rule induction – Neural networks : Learning and and Generalisation, competitive learning, Principal component analysis and neural networks ; Fuzzy Logic : extracting fuzzy models from data , fuzzy decision trees, Stochastic search methods.

#### **UNIT – III**

**Mining Data Streams:** Introduction to Streams Concepts – Stream data model and architecture – Stream Computing , Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform ( RTAP) applications – case studies – real time sentiment analysis, stock market predictions.



#### **UNIT – IV**

**Frequent Itemsets and clustering:** Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

#### **UNIT – V**

**Frame Works and Visualization:** MapReduce – Hadoop, Hive , MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques : systems and Applications .

#### **TEXT BOOKS:**

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

#### **REFERENCE BOOKS:**

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
NON-CONVENTIONAL POWER GENERATION  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE511OE**

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**Prerequisite:** Nil.

**Course Objectives:**

- To introduce various types of renewable energy technologies
- To understand the technologies of energy conversion from the resources and their quantitative analysis.

**Course Outcomes:** After completion of this course, the student will be able to

- Analyze solar thermal and photovoltaic systems and related technologies for energy conversion.
- Understand Wind energy conversion and devices available for it.
- Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies.
- Realize Power from oceans (thermal, wave, tidal) and conversion devices.
- Understand fundamentals of fuel cells and commercial batteries.

**UNIT - I**

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still.

**UNIT - II**

Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics- Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking - Solar Thermo electric conversion.

**UNIT - III**

Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit- Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems.

**UNIT - IV**

Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion - Factors affecting

generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers – Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

#### **UNIT - V**

OTEC Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves-Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Advantages and disadvantages - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

#### **TEXT BOOKS:**

1. “John Twidell & Wier”, “Renewable Energy Resources”, CRC Press, 2009.
2. “G. D. Rai”, “Non Conventional Energy sources”, Khanna publishers, 2004

#### **REFERENCE BOOKS:**

1. “D. P .Kothari, Singal, Rakesh and Ranjan”, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. “F. C. Treble”, Generating Electricity from Sun, Pergamon Press, 1<sup>st</sup> Edition 1991
3. “C. S. Solanki”, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009
4. “S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
ELECTRICAL ENGINEERING MATERIALS  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE512OE**

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**Prerequisite:** Engineering chemistry and Engineering Physics - II

**Course Objective:**

- To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

**Course Outcomes:** After completion of this course, the student will be able to

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Acquire Knowledge on Materials used in electrical engineering and applications.

**UNIT- I**

**Dielectric Materials:** Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

**UNIT – II**

**Magnetic Materials:** Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

**UNIT – III**

**Semiconductor Materials:** Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI)

**UNIT – IV**

**Materials for Electrical Applications:** Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

**UNIT – V**

**Special Purpose Materials:** Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI

**Text Books:**

1. “R K Rajput”, “ A course in Electrical Engineering Materials”, Laxmi Publications, 2009
2. “T K Basak”, “ A course in Electrical Engineering Materials”, New Age Science Publications 2009

**Reference Books:**

1. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
2. “AdrianusJ.Dekker”, Electrical Engineering Materials, PHI Publication, 2006.
3. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & Sons, 2011.

**B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING  
NANOTECHNOLOGY  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE513OE**

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**Course Objectives:** Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

**Course Outcomes:** The present syllabus of “Introduction to Nano Technology” will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

**UNIT - I**

**Introduction:** History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

**UNIT - II**

**Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials:** Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

**Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

**Magnetic Properties:** Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

**UNIT- III**

**Synthesis Routes: Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders:** Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

**UNIT - IV**

**Tools to Characterize nanomaterials:** X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope

(STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

#### **UNIT - V**

**Applications of Nanomaterials:** Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

#### **TEXT BOOKS:**

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

#### **REFERENCES BOOKS:**

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
DESIGN ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE621OE**

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**Prerequisite:** Power systems - I & Power Systems - II

**Course Objectives:**

- To emphasize the estimation and costing aspects of all electrical equipment, installation and designs on the cost viability.
- To design and estimation of wiring
- To design overhead and underground distribution lines, substations and illumination

**Course Outcomes:** After Completion of this course, student will be able to

- Understand the design considerations of electrical installations.
- Design electrical installation for buildings and small industries.
- Identify and design the various types of light sources for different applications.

**UNIT - I**

**Design Considerations of Electrical Installations:** Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections , Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

**UNIT - II**

**Electrical Installation for Different Types of Buildings and Small Industries:** Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.

**UNIT - III**

**Overhead and Underground Transmission and Distribution Lines:** Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.



#### **UNIT - IV**

**Substations:** Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

#### **UNIT - V**

**Design of Illumination Schemes:** Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes LED, CFL and OCFL differences.

#### **Text Books:**

1. “K. B. Raina, S. K. Bhattacharya”, “Electrical Design Estimating and Costing”, New Age International Publisher, 2010.
2. “Er. V. K. Jain, Er. Amitabh Bajaj”, “Design of Electrical Installations”, University Science Press.

#### **Reference Books:**

1. Code of practice for Electrical wiring installations, (System voltage not exceeding 650 volts), Indian Standard Institution, IS: 732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS: 4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding 650 V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthing, Indian Standard Institution, IS: 3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. “Gupta J. B., Katson, Ludhiana”, “Electrical Installation, estimating and costing”, S. K. Kataria and sons, 2013.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ENERGY STORAGE SYSTEMS**  
**(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE622OE**

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**Prerequisite:** Electro chemistry

**Course Objective:**

- To enable the student to understand the need for energy storage, devices and technologies available and their applications

**Course Outcomes:** After completion of this course, the student will be able to

- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

**UNIT - I**

**Electrical Energy Storage Technologies:** Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

**UNIT - II**

**Needs for Electrical Energy Storage:** Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

**UNIT - III**

**Features of Energy Storage Systems:** Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H<sub>2</sub>), Synthetic natural gas (SNG).

**UNIT - IV**

**Types of Electrical Energy Storage systems:** Electrical storage systems, Double-layer capacitors (DLC) , Superconducting magnetic energy storage (SMES), Thermal storage systems , Standards for EES, Technical comparison of EES technologies.

## **UNIT - V**

**Applications:** Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA–aggregation of many dispersed batteries.

### **Text Books:**

1. “James M. Eyer, Joseph J. Iannucci and Garth P. Corey “, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

### **Reference Book:**

1. “Jim Eyer, Garth Corey”, Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
INTRODUCTION TO MECHATRONICS  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE623OE**

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**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**

**Introduction:** Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**Signal Conditioning :** Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registers, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resettable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

### **UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview :** 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

### **UNIT – IV**

**Programmable Logic Controllers :** Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

### **UNIT – V**

**Programmable Motion Controllers :** Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

### **TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

### **REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. “Designing Intelligent Machines”. open University, London.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
ENTREPRENEUR RESOURCE PLANNING  
(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EE831OE**

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**(Students must read text book. Faculty is free to choose any other cases)**

**Course Objectives:** It enables the student to understand the foundations of Enterprise planning and ERP System Options.

**Course Outcome:** The student understands the challenges in implementation of ERP system, ERP System Implementation options, and functional modules of ERP.

1. Introduction to ERP- Foundation for Understanding ERP systems-Business benefits of ERP-The challenges of implementing ERP system-ERP modules and Historical Development.

Case: Response top RFP for ban ERP system (Mary Sumner).

2. ERP system options & Selection methods-Measurement of project Impact-information Technology Selection-ERP proposal evaluation-Project Evaluation Technique.(David L. olson).

Case: Atlantic Manufacturing (Mary Sumner).

3. ERP system Installation Options- IS/IT Management results-Risk Identification analysis-System Projects- Demonstration of the system-Failure method-system Architecture & ERP (David L. Olson)

Case: Data Solutions & Technology Knowledge (Mary Sumner).

4. ERP - sales and Marketing- Management control process in sales and marketing - ERP customer relationship management - ERP systems- Accounting & Finance control processes. Financial modules in ERP systems.

Case: Atlantic manufacturing (Mary Sumner).

5. ERP – Production and Material Management-Control process on production and manufacturing - Production module in ERP- supply chain Management & e-market place-e-business & ERP-e supply chain & ERP- Future directions for ERP.

Case: HR in Atlantic manufacturing. (Mary Sumner).

### **UNIT - I**

**ERP and Technology:** Introduction – Related Technologies – Business Intelligence – E-Commerce and E Business – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM

### **UNIT - II**

**ERP Implementation:** Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks –Requirements Definition – Methodologies – Package selection –

Project Teams –Process Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities.

### **UNIT - III**

**ERP In Action & Business Modules:** Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance –Materials Management – Quality management – Marketing – Sales, Distribution and service.

### **UNIT - IV**

**ERP Market:** Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc –SSA Global – Lawson Software – Epicor – Intutive.

### **UNIT - V**

Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP.

### **TEXT BOOKS:**

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

### **REFERENCE BOOKS:**

1. Jim Mazzullo, “SAP R/3 for Everyone”, Pearson, 2007.
2. Jose Antonio Fernandz, “The SAP R /3 Handbook”, Tata McGraw Hill, 1998.
3. Biao Fu, “SAP BW: A Step-by-Step Guide”, First Edition, Pearson Education, 2003.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
MANAGEMENT INFORMATION SYSTEM (MIS)  
(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EE832OE**

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**Course Objective:**

- To provide the basic concepts of Enterprise Resource Planning and Management of Information System.
- Explain to students why information systems are so important today for business and management;
- Evaluate the role of the major types of information systems in a business
- Assess the impact of the Internet and Internet technology on business-electronic commerce and electronic business;
- Identify the major management challenges to building and using information systems and learn how to find appropriate solutions to those challenges

**Course Outcomes:** The completion of the subject, the student will be able to

- Understand the usage of MIS in organizations and the constituents of the MIS
- Understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
- Assess the requirement and stage in which the organization is placed. Nolan model is expected to aid such decisions
- Learn the functions and issues at each stage of system development. Further different ways in which systems can be developed are also learnt.

**UNIT – I**

**Introduction to IS Models and Types of Information systems:** – Nolan Stage Hypothesis, IS Strategic Grid, Wards Model, Earl's Multiple Methodology, Critical Success Factors, Soft Systems Methodology, Socio-Technical Systems Approach (Mumford), System Develop Life Cycle, Prototype and End User Computing, Application Packages, Outsourcing, Deciding Combination of Methods. Types of Information Systems

**UNIT – II**

**IS Security, Control and Audit**– System Vulnerability and Abuse, business value of security and control, Need for Security, Methods of minimizing risks IS Audit, ensuring system quality.

**UNIT – III**

**Induction to ERP:** Overview of ERP, MRP, MRPII and Evolution of ERP, Integrated Management Systems, Reasons for the growth of ERP, Business Modeling, Integrated Data



Model, Foundations of IS in Business, Obstacles of applying IT, ERP Market- ERP Modules: Finance, Accounting Systems, Manufacturing and Production Systems, Sales and Distribution Systems, , Human Resource Systems, Plant Maintenance System, Materials Management System, Quality Management System, ERP System Options and Selection, ERP proposal Evaluation.

#### **UNIT – IV**

**Benefits of ERP:** Reduction of Lead Time, On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.

#### **UNIT – V**

**ERP Implementation and Maintenance:** Implementation Strategy Options, Features of Successful ERP Implementation, Strategies to Attain Success, User Training, Maintaining ERP & IS. Case Studies.

#### **TEXT BOOKS:**

1. Gordon B. Davis & Margrethe H. Olson: Management Information Systems, TMH, 2009.
2. C Laudon and Jane P. Laudon, et al: Management Information Systems, Pearson Education, 2009.
3. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
4. C. S. V. Murthy: Management Information System, Himalaya, 2009
5. James A. Obrein: Management Information Systems, TMH, 2009
6. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
7. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
8. Vaman, ERP in Practice, TMH, 2009

#### **REFERENCE BOOKS:**

1. Dharminder and Sangeetha: Management Information Systems, Excel, 2009
2. Gerald V. Post, David L Anderson: Management Information Systems, Irvin McGraw Hill, 2009.
3. Monk: Concepts in ERP, Cengage, 2009
4. Olson: Managerial Issues of ERO, TMH, 2009
5. Motiwala: Enterprise Resource Planning, Pearson 2009
6. Miller: MIS—Cases, Pearson, 2009

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ORGANIZATIONAL BEHAVIOUR**  
**(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EE833OE**

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**Course Objective:**

- To provide the students with the conceptual framework and the theories underlying Organisational Behaviour.

**Course Outcomes:** Upon the completion of the subject, the student will be able to

- Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
- Assess the potential effects of organizational level factors (such as structure, culture and change) on organizational behaviour.
- Critically evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behaviour.
- Analyse organizational behavioural issues in the context of organizational behaviour theories, models and concepts.

**UNIT – I**

Introduction to OB - Definition, Nature and Scope –Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour. Cognitive Processes-I : Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization - Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

**UNIT – II**

Cognitive Processes-II: Personality and Attitudes - Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organisational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

**UNIT – III**

Dynamics of OB-I: Communication – types - interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision making techniques – creativity and group decision making . Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of

conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.

#### **UNIT – IV**

Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups –dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

#### **UNIT – V**

Leading High performance: Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

#### **TEXT BOOKS:**

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4. Newstrom W. John & Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.
7. Pareek Udai: Behavioural Process at Work:, Oxford & IBH, New Delhi, 2009.

#### **REFERENCE BOOKS:**

1. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.
2. Hitt: Organizational Behaviour, Wiley, 2008
3. Aswathappa: Organisational Behaviour, Himalaya, 2009
4. Mullins: Management and Organisational Behaviour, Pearson, 2008.
5. McShane, Glinow: Organisational Behaviour--Essentials, TMH, 2009.
6. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING  
ELECTRONIC MEASUREMENTS AND INSTRUMENTATION  
(Open Elective – I)**

**B.Tech. III Year I Sem.  
Course Code: EI511OE**

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**Prerequisite: Nil**

**Course Objectives:**

- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:** On completion of this course student can be able to

- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

**UNIT - I**

**Block Schematics of Measuring Systems:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag ;Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

**UNIT - II**

**Signal Analyzers:** AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. **Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

### **UNIT - III**

**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

**Special Purpose Oscilloscopes:** Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

### **UNIT - IV**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

### **UNIT - V**

**Bridges:** Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**Measurement of Physical Parameters:** Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

### **TEXT BOOKS:**

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2<sup>nd</sup> Edition 2004.

### **REFERENCE BOOKS:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbins, W.D. Cooper: PHI 5<sup>th</sup> Edition 2003.
3. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**INDUSTRIAL ELECTRONICS**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EI621OE**

**L T P C**  
**3 0 0 3**

**Pre-requisites:** Basic Electrical and Electronics Engineering or Electronic Devices and Circuits.

**UNIT - I**

**DC Amplifiers:** Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

**UNIT - II**

**Regulated Power Supplies:** Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection.

**Switched Mode & IC Regulators:** Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting .

**UNIT - III**

**SCR and Thyristor:** Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.

**UNIT - IV**

**Applications of SCR in Power Control:** Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave.

**DIAC, TRIAC and Thyristor Applications:** Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.

**UNIT - V**

**Industrial Applications - I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators.

Electric Welding Classification, types and methods of Resistance and ARC welding, Electronic DC Motor Control.

**Industrial Applications - II:** High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties,

Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications.

**TEXTBOOKS:**

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

**REFERENCE BOOKS:**

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6<sup>th</sup> Edn., 2003.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.3.
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**SENSORS AND TRANSDUCERS**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EI831OE**

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**Pre-requisites:** Nil

**Course Objectives:** To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities and the following:

- Various types of Sensors & Transducers and their working principle
- Resistive, Capacitive and Inductive transducers
- Some of the miscellaneous transducers
- Characteristics of transducers

**Course Outcomes:** Upon completion of this course the student shall be able to understand the working of basic sensors and transducers used in any industries.

**UNIT – I**

**Measurements and Instrumentation of Transducers:** Measurements – Basic method of measurement – Generalized scheme for measurement systems – Units and standards – Errors – Classification of errors, error analysis – Statistical methods – Sensor – Transducer – Classification of transducers – Basic requirement of transducers.

**UNIT – II**

**Characteristics of Transducers:** Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs

**UNIT – III**

**Resistive Transducers:** Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer

**UNIT – IV**

**Inductive and Capacitive Transducer:** Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.



**UNIT – V**

**Miscellaneous Transducers:** Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers

**TEXT BOOKS:**

1. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Patranabis. D, “Sensors and Transducers”, Prentice Hall of India, 2003.

**REFERENCE BOOKS:**

1. Renganathan. S, “Transducer Engineering”, Allied Publishers, Chennai, 2003.
2. Doebelin. E.A, “Measurement Systems – Applications and Design”, Tata McGraw Hill, New York, 2000.
3. John. P, Bentley, “Principles of Measurement Systems”, III Edition, Pearson Education, 2000.
4. Murthy. D. V. S, “Transducers and Instrumentation”, Prentice Hall of India, 2001.
5. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
6. Instrument Transducers – An Introduction to their Performance and design – by Herman K. P. Neubrat, Oxford University Press.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**PC BASED INSTRUMENTATION**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EI832OE**

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**Course Objective:** To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation, and programming.

**UNIT – I**

**Introduction to Computer Instrument Communication:** Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.

**UNIT – II**

**Programmable logic controller (PLC) basics:** Definition, overview of PLC systems, input/output modules, power supplies, and isolators.

**Basic PLC programming:** Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

**UNIT – III**

**PLC intermediate and advanced functions:** Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

**UNIT – IV**

**Application of PLC:** Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating

**UNIT – V**

**Related Topics:** Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting, and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves, and smart actuators.

**TEXT BOOKS**

1. Programmable Logic Controllers – Principles and Applications, John. W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New Jersey, 1998.
2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

**REFERENCES**

1. PC Based Instrumentation and Control Third Edition by Mike Tooley ; Elsevier.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation, and Control. By Kevin James; Elsevier.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.
4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.
5. 5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, New York, 1997.
6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

**B.TECH. MECHANICAL ENGINEERING  
OPTIMIZATION TECHNIQUES  
(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: ME511OE**

**L T/P/D C**  
**3 0/0/0 3**

**Prerequisite:** Mathematics –I & Mathematics –II

**Course Objectives:**

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

**Course Outcomes:** After completion of this course, the student will be able to

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

**UNIT – I**

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**

**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems.

### **UNIT – III**

**Unconstrained Nonlinear Programming:** One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques:** Univariate method, Powell's method and steepest descent method.

### **UNIT – IV**

**Constrained Nonlinear Programming:** Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

### **UNIT – V**

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

### **TEXT BOOKS:**

3. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4<sup>th</sup> edition, 2009.
4. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

### **REFERENCE BOOKS:**

4. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3<sup>rd</sup> edition, 2003.
5. H.A. Taha, "Operations Research: An Introduction", 8<sup>th</sup> Edition, Pearson/Prentice Hall, 2007.
6. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

**B.TECH. MECHANICAL ENGINEERING  
COMPUTER GRAPHICS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: ME512OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:**

- To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
- To make the student present the content graphically.

**Course Outcomes:**

- Students can animate scenes entertainment.
- Will be able work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

**UNIT - I**

**Introduction:** Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

**Output primitives:** Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

**UNIT - II**

**2-D Geometrical transforms:** Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

**2-D Viewing:** The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

**UNIT - III**

**3-D Object representation:** Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces, sweep representations, octrees BSP Trees,

**3-D Geometric transformations:** Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

#### **UNIT - IV**

**Visible surface detection methods:** Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

**Illumination Models and Surface rendering Methods:** Basic illumination models, polygon rendering methods

#### **UNIT- V**

**Computer animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

#### **TEXT BOOKS:**

1. "Computer Graphics C version", Donald Hearn and M. Pauline Baker, Pearson education.
2. "Computer Graphics Second edition", Zhigand xiang, Roy Plastock, Schaum's outlines, Tata Mc Graw hill edition.

#### **REFERENCE BOOKS:**

1. "Computer Graphics Principles & practice", second edition in C, Foley, Van Dam, Feiner and Hughes, Pearson Education.
2. "Procedural elements for Computer Graphics", David F Rogers, Tata Mc Graw hill, 2nd edition.
3. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
4. "Principles of Computer Graphics", Shalini, Govil-Pai, Springer.
5. "Computer Graphics", Steven Harrington, TMH
6. Computer Graphics, F. S. Hill, S. M. Kelley, PHI.
7. Computer Graphics, P. Shirley, Steve Marschner & Others, Cengage Learning.
8. Computer Graphics & Animation, M. C. Trivedi, Jaico Publishing House.
9. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor&Francis Group.
10. Computer Graphics, Rajesh K.Maurya, Wiley India.

**B.TECH. MECHANICAL ENGINEERING  
INTRODUCTION TO MECHATRONICS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: ME513OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**

**Introduction:** Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**Signal Conditioning :** Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registers, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resettable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets



### **UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview :** 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

### **UNIT – IV**

**Programmable Logic Controllers :** Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

### **UNIT – V**

**Programmable Motion Controllers :** Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

### **TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

### **REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. “Designing Intelligent Machines”. open University, London.

**B.TECH. MECHANICAL ENGINEERING**  
**FUNDAMENTALS OF MECHANICAL ENGINEERING**  
**(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: ME514OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre-Requisites:** None

**Course Objectives:** Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

**Course Outcomes:** After learning the course the students should be able to

- To understand the fundamentals of mechanical systems.
- To understand and appreciate significance of mechanical engineering in different Fields of engineering.

**UNIT - I**

**Introduction:** Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.

**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion.

**UNIT - II**

**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process

**Properties of Steam:** Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters.

**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

**UNIT - III**

**Heat Engines:** Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles.

**Internal Combustion Engines:** Introduction, Classification, Engine details, four- stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies.

**UNIT - IV**

**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming

**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistage.

**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

#### **UNIT - V**

**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc).

**Transmission of Motion and Power:** Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

**Engineering Materials:** Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer.

#### **TEXT BOOKS:**

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson
2. Introduction to Engineering Materials / B.K. Agrawal/ Mc Graw Hill

#### **REFERENCE BOOKS:**

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria

**B.TECH. MECHANICAL ENGINEERING**  
**WORLD CLASS MANUFACTURING**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: ME621OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre-requisites:** None

**Course Objectives:** To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

**Course Outcomes:** Students should be able to compare the existing industry with WCM companies.

**UNIT - I**

**Information Age and Global Competitiveness:** The Emergence of Information Age; Competition and Business Challenge; Operating Environment; Globalization and International Business; Global Competitiveness and Manufacturing Excellence; World Class Manufacturing and Information Age Competition; Manufacturing Challenges, Problems in Manufacturing Industry.

**UNIT - II**

**Cutting Edge Technology:** Value Added Engineer in - Hall's Framework; Schonberger's Framework of WCM; Gunn's Model; Maskell's Model.

**Philosophy of World Class Manufacturing:** Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management; Culmination of WCM.

**UNIT - III**

**System and Tools for World Class Manufacturing:** The Integration Imperative; Overview of Systems and Tools; Information Management Tools - Product and Process Design Tools, Bar Code Systems, Kanban: A Lean Production Tool, Statistical Quality Control (SQC), Material Processing, and Handling Tools; Assessment of Manufacturing Systems and Tools.

**Labor and HRD Practices in WCM:** Human Resource Dimensions in WCM; Morale and Teamwork; High Employee Involvement; Cross Functional Teams; Work Study Methods; Human Integration Management.

**UNIT - IV**

**Competitive Indian Manufacturing:** Manufacturing Performance and Competitiveness - Indian Firms: Manufacturing Objectives and Strategy; Usage of Management Tools and Technologies; Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure.

**Globalization and World Class Manufacturing:** Generic Manufacturing Strategies for Information Age; Planning Methodology and Issues in Strategic Planning of WCM; Performance Measurement - PO-P System, TOPP System and Ambite System.

**UNIT - V**

**The Future WCM:** Manufacturing Strategy: Futile Search for an Elusive Link, Manufacturing Strategic Intent Classification, Translating Intent into Action.

**Case Studies:** Accelerated Fermentation Process – Using World Class Enzymes; Birla Cellulosic Kharach.

**TEXT BOOKS:**

1. World Class Manufacturing- A Strategic Perspective / BS Sahay, KBS Saxena & Ashish Kumar / Macmillan
2. Making Common Sense Common Practice – Models for Manufacturing Excellence / Ron Moore / Butter Worth Heinemann

**REFERENCE BOOKS:**

1. Managing Technology and Innovation for Competitive Advantage / V. K. Narayanan/ Prentice Hall
2. World Class Manufacturing - The Lesson of Simplicity / Richard J Schonberger / Free Press

**B.TECH. MECHANICAL ENGINEERING  
FUNDAMENTALS OF ROBOTICS  
(Open Elective – II)**

**B.Tech. III Year II Sem.**

**L T/P/D C**

**Course Code: ME622OE**

**3 0/0/0 3**

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course outcomes:** After this completion of this course, the student should be able to

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications.
- Design intelligent robots using sensors.

**UNIT - I**

Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system & chain type: Serial manipulator & Parallel Manipulator. Components of Industrial robotics-precision of movement-resolution, accuracy & repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors,& Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force or Torque sensors.

**UNIT - II**

Grippers - Mechanical Gripper-Grasping force-Engelberger-g-factors-mechanisms for actuation, Magnetic gripper , vaccume cup gripper-considerations in gripper selection & design . Industrial robots specifications. Selection based on the Application .

**UNIT - III**

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots

**UNIT - IV**

Trajectory planning: Joint space scheme- Cubic polynomial fit-Obstacle avoidance in operation space-cubic polynomial fit with via point, blending scheme. Introduction Cartesian space scheme.

Control- Interaction control, Rigid Body mechanics, Control architecture- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

**UNIT - V**

Programming of Robots and Vision System-Lead through programming methods- Teach pendent- overview of various textual programming languages like VAL etc.

Machine (robot) vision:

**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

**REFERENCE BOOKS:**

1. Theory of Applied Robotics /Jazar/Springer.
2. Robotics / Ghosal / Oxford

**B.TECH. MECHANICAL ENGINEERING  
FABRICATION PROCESSES  
(Open Elective –II)**

**B.Tech. III Year II Sem.**  
**Course Code: ME623OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** Understand the philosophies of various Manufacturing process.

**Course Outcomes:** For given product, one should be able identify the manufacturing process.

**UNIT – I**

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.

Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – IV**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion



**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T.V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING**  
**TOTAL QUALITY MANAGEMENT**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: ME831OE**

**L T/P/D C**  
**3 0/0/0 3**

**UNIT - I**

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

**UNIT -II**

**Customer Focus and Satisfaction:** Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

**Bench Marking:** Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

**UNIT- III**

**Organizing for TQM:** The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, Ishikawa diagram, paneto diagram, Kepner & Tregoe Methodology.

**UNIT- IV**

**The Cost of Quality:** Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

**UNIT -V**

**ISO9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

**TEXT BOOK:**

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

**REFERENCE BOOKS:**

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

**B.TECH. MECHANICAL ENGINEERING**  
**INDUSTRIAL SAFETY, HEALTH, AND ENVIRONMENTAL ENGINEERING**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: ME832OE**

**L T/P/D C**  
**3 0/0/0 3**

**Pre-requisites:** None

**Course Objectives:**

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1948 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

**Course Outcomes:**

- To list out important legislations related to Health , Safety and Environment
- To list out requirements mentioned in factories act for the prevention of accidents. To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

**UNIT - I**

**Factories Act – 1948 :** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Telangana Factories Rules 1950 under Safety and health chapters of Factories Act 1948

**UNIT II**

**Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

### **UNIT - III**

#### **Manufacture, Storage and Import of Hazardous**

**Chemical Rules 1989** : Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

### **UNIT - IV**

**Other Acts and Rules** : Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act

### **UNIT - V**

**International Acts and Standards:** Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Helath and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

### **TEXT BOOKS:**

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Industrial Safety, Health and Environment Management Systems / R. K. Jain, Sunil S. Rao / Khanna Publishers.

### **REFERENCE BOOKS:**

1. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
4. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
5. The manufacture, storage, and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

**B.TECH. MECHANICAL ENGINEERING**  
**BASICS OF THERMODYNAMICS**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**

**L T/P/D C**

**Course Code: ME833OE**

**3 0/0/0 3**

**Pre-requisite:** Engineering Chemistry and Physics

**Course Objective:** To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

**Course Outcomes:** At the end of the course, the student should be able to:

- Understand and differentiate between different thermodynamic systems and processes
- Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes
- Understand and analyze the Thermodynamic cycles

**UNIT – I**

**Introduction: Basic Concepts:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility

**UNIT - II**

Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

**UNIT – III**

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats ( $c_p$  and  $c_v$ ), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

**UNIT - IV**

Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const.

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Psychrometric chart.

#### **UNIT - V**

**Power Cycles:** Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

**Refrigeration Cycles:** Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

#### **TEXT BOOKS:**

1. Basic Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Engineering Thermodynamics / Chattopadhyay/ Oxford

#### **REFERENCE BOOKS:**

1. Thermodynamics for Engineers / Kenneth A. Kroos , Merle C. Potter/ Cengage
2. Thermodynamics /G.C. Gupta /Pearson

**B.TECH. MECHANICAL ENGINEERING**  
**RELIABILITY ENGINEERING**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**

**L T/P/D C**

**Course Code: ME834OE/AM852PE/EI862PE**

**3 0/0/0 3**

**Prerequisite:** Mathematics III

**Course Objectives:**

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

**Course Outcomes:** After completion of this course, the student will be able to

- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irreparable systems

**UNIT – I**

**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

**Definition of Reliability:** Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

**UNIT – II**

**Network Modeling and Evaluation Of Simple Systems:** Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.

**Network Modeling and Evaluation of Complex systems:** Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

**UNIT – III**

**Time Dependent Probability:** Basic concepts- Reliability function  $f(t)$ .  $F(t)$ ,  $R(t)$  and  $h(t)$  - Relationship between these functions.

**Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

#### **UNIT – IV**

**Discrete Markov Chains:** Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

**Continuous Markov Processes:** Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

#### **UNIT – V**

**Frequency and Duration Techniques:** Frequency and duration concepts, application to multi state problems, Frequency balance approach.

**Approximate System Reliability Evaluation:** Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

#### **TEXT BOOKS:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

#### **REFERENCE BOOK:**

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993.



**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
FABRICATION PROCESSES  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: NT511OE**

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**Course Objectives:** Understand the philosophies of various Manufacturing process.

**Course Outcomes:** For given product, one should be able identify the manufacturing process.

**UNIT – I**

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.

Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – IV**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T. V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
NON DESTRUCTIVE TESTING METHODS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: NT512OE**

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**Course overview:** The aim is to introduce students the overview of the non destructive testing methods of materials. The course covers NDE, Ultrasonic, MPI testing of metal parts. It gives an idea about selection of the testing criteria. It briefly describe the thermo-graph and radio graph methods of testing and provide selection properties for different tests.

**Course Objectives:** This course has the basic idea of the properties of steel and ferrous metals. The objectives aim to:

- Identify the basic methods of testing.
- Understand the concept of non destructive testing.
- Describe the various types of NDT tests carried out on components.
- Describe ultrasonic method of testing the materials.
- Analyze the different types of test carried out on components and surfaces.
- Understand the properties of materials suitable for NDT test.
- Understand the radiography uses in engineering.

**Course Outcomes:** At the end of the course the students are able to:

- Identify the requirements of testing criteria as per material composition.
- Understand the theory of non destructive testing methods is used.
- Determine the type of requirement of non destructive test.
- Distinguish between the various NDT test as Ultrasonic and Eddy current methods.
- Understand the properties of radiation used in engineering.
- Describe the various types of non destructive test used to determine the surface cracks.

#### **UNIT - I**

**Overview of NDT** - NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.

#### **UNIT - II**

**Surface NDE Methods:** Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection

materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

### **UNIT - III**

**Thermography and Eddy Current Testing** - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

### **UNIT - IV**

**Ultrasonic Testing and Acoustic Emission** - Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications

### **UNIT - V**

**Radiography** - Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

### **TEXT BOOKS:**

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

### **REFERENCES:**

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
FUNDAMENTALS OF ENGINEERING MATERIALS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: NT513OE**

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**Course Overview:**

The aim is to introduce students the overview of the properties of materials used in engineering manufacturing process. The course covers basic concept of ferrous, non-ferrous metals and its alloys. It emphasizes on transformation of iron at various temperatures. It briefly describes the heat treatment given to iron and its alloys. It gives the general overview idea of composite materials.

**Course Objectives:** This course has the basic idea of the properties of steel and ferrous metals. The objectives aim to:

- Identify the basic crystalline structure of steel.
- Understand the concept of TTT.
- Describe the various heat treatment methods to obtain the desired properties.
- Describe the composition of carbon contents in steel.
- Analyze the different forms of iron obtained during heating of steel.
- Understand the properties of non-ferrous alloys.
- Understand requirement.

**Course Outcomes:** At the end of the course the students are able to:

- This subject gives student a technical knowledge about behavior of metals.
- Identify the crystalline structure of steel.
- Understand the theory of time temperature and transformation.
- Determination of different uses of heat treatment in steel.
- Distinguish between the various forms of steel.
- Understand the properties of non-ferrous alloys.
- Describe the various uses of composite materials.

**UNIT – I**

**Structure of Metals:** Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

**UNIT –II**

**Phase Diagrams:** Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

**UNIT – III**

**Steels:** Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe<sub>3</sub>C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

**UNIT – IV**

**Cast Irons:** Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

**UNIT – V**

**Ceramics, Polymers and Composites:** Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

**TEXT BOOKS:**

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R. Askeland / Thomson.

**REFERENCE BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and engineering / William and Callister.
3. Elements of Material science / V. Rahghavan

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
INTRODUCTION TO MATERIALS HANDLING  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: NT621OE**

**L T P C**  
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**Course Overview**

Course covers a systems approach to managing activities associated with traffic, transportation, inventory management, warehousing, packaging, order processing, and materials handling. This course is designed to give students a comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout.

**Course Objectives:**

- To develop competency for system visualization and design.
- To enable student to design cylinders and pressure vessels and to use IS code.
- To enable student select materials and to design internal engine components.
- To introduce student to optimum design and use optimization methods to design mechanical components.
- To enable student to design machine tool gearbox.
- To enable student to design material handling systems.
- Ability to apply the statistical considerations in design and analyze the defects and failure modes in

**Course Outcomes:**

- Demonstrate ability to successfully complete Fork Lift Certification to safely and effectively operate in the manufacturing environment.
- Demonstrate proficiency in supply chain operations, utilizing appropriate methods to plan and implement processes necessary for the purchase and conveyance of goods in a timely and cost-effective manner
- It explains about the different types of material handling, advantages and disadvantages. It also suggests the selection procedure for the material handling along with its specifications.
- Need for Material handling also explained with different techniques like Automated Material handling Design Program, Computerized material handling Planning will be dealt.
- The Material handling is explained with models, selection procedure of material handling is depending on different function oriented systems. This also related with plant layout by which the minimization of the handling charges will come down.
- The ergonomics related to material handling equipment about design and miscellaneous equipments.

**UNIT – I**

Types of intraplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications. Introduction to control of hoisting equipments.

**UNIT – II**

Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of hain sand ropes , different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

**UNIT – III**

Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

**UNIT – IV**

Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

**UNIT – V**

Different drives of hosting gears like individual and common motor drive for several mechanisms, traveling gear, traveling mechanisms for moving trolleys and cranes on runway rails, mechanisms for trackless, rubber-tyred and crawler cranes motor propelled trolley hoists and trolleys, rails and traveling wheels, slewing, jib and luffing gears. Operation of hoisting gear during transient motion, selecting the motor rating and determining braking torque for hoisting mechanisms, drive efficiency calculations, selecting the motor rating and determining braking torque for traveling mechanisms, slewing mechanisms, jib and luffing mechanisms. (Elementary treatment is expected)

**TEXT BOOKS:**

1. Materials Handling Equipment – N. Rudenko , Envee Publishers, New Delhi
2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow

**REFERENCE BOOKS:**

1. Aspects of Material handling - Arora
2. Introduction to Material Handling- Ray
3. Plant Layout and Material Handling- Chowdary RB



**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
NON-CONVENTIONAL ENERGY SOURCES  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: NT622OE**

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**Course Overview:**

Non Conventional resources include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Non Conventional energy technologies produce power, heat or mechanical energy by converting those resources either to electricity or to motive power. The policy maker concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications. Such commercial technologies include hydroelectric power, solar energy, fuels derived from biomass, wind energy and geothermal energy. Wave, ocean current, ocean thermal and other technologies that are in the research or early commercial stage, as well as non-electric Non Conventional energy technologies, such as solar water heaters and geothermal heat pumps, are also based on Non Conventional resources, but outside the scope of this Manual.

**Course Objectives:**

- Graduates will demonstrate the ability to use basic knowledge in mathematics, science and engineering and apply them to solve problems specific to mechanical engineering (Fundamental engineering analysis skills).
- Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results (Information retrieval skills).
- Graduates should be capable of self-education and clearly understand the value of life-long learning (Continuing education awareness).
- Graduates will develop an open mind and have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues (Social awareness).
- Graduate will be able to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete project (Practical engineering analysis skills).

**Course Outcomes:**

- Introduction to Renewable Energy Sources, Principles of Solar Radiation, Different Methods of Solar Energy Storage and its Applications, Concepts of Solar Ponds, Solar Distillation and Photo Voltaic Energy Conversion

- Introduction to Flat Plate and Concentrating Collectors ,Classification of Concentrating Collectors
- Introduction to Wind Energy, Horizontal and Vertical Access Wind Mills, Bio-Conversion
- Types of Bio-Gas Digesters and Utilization for Cooking Geothermal Energy Resources
- Types of Wells and Methods of Harnessing the Energy, Ocean Energy and Setting of OTEC Plants
- Tidal and Wave Energy and Mini Hydel Power Plant, Need and Principles of Direct Energy Conversion
- Concepts of Thermo-Electric Generators and MHD Generators

### **UNIT - I**

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

### **UNIT - II**

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

### **UNIT - II**

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion - Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors- Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

### **UNIT - IV**

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features- Atmospheric exhaust and condensing, exhaust types of conventional steam turbines.

Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

### **UNIT - V**

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small

cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

**TEXT BOOKS:**

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.

**REFERENCE BOOKS:**

1. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
2. Wakil MM, *Power Plant Technology*, Mc Graw Hill Book Co, New Delhi, 2004.
3. Non - Conventional Energy Sources. Rai

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
ROBOTICS  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: NT623OE**

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**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

#### **UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

**Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

#### **UNIT – II**

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

### **UNIT – III**

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

### **UNIT IV**

#### **Robot actuators and Feedback components:**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

### **UNIT V**

#### **Robot Application in Manufacturing:**

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

#### **TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

#### **REFERENCE BOOKS:**

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
CONCEPTS OF NANO SCIENCE AND TECHNOLOGY  
(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: NT831OE**

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**Course Objectives:**

- Beginners will be able to acquaint themselves with the excited subject though they are novice, whereas advanced learners will equip themselves to solve the complicated issues further.
- To know the importance of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties and characterization; investigations into the various factors influence the properties of nanomaterials, optimizing the procedures, and implementations to the new designs
- To provide a sound understanding of the various concepts involved in fabrication of device architectures' and able to evaluate them in advance

**Course Outcome:** The intended course covers the whole spectrum of nanomaterials ranging from introduction, classification, synthesis, properties, and characterization tools of nanophase materials to application including some new developments in various aspects.

**UNIT - I**

**Introduction to Nano:** Importance, Definition and scope, Nano size, challenges, applications. Electrons, Other Materials, Nano magnetism as a case study; Fundamental terms (Physics & Chemistry) in nano-science and technology; Feynman's perspective; Scaling laws pertaining to mechanics, optics, electromagnetism; Importance of Quantum mechanics, statistical mechanics and chemical kinetics in nano-science and technology;

**UNIT - II**

**Classification of nano materials:** Scientific basis for top-down and bottom-up approaches to synthesize Nanomaterials; How to characterize Nanomaterials?

**UNIT - III**

**Tools for Nanoscience and Technology:** Tools for measuring properties of Nanostructures, Tools to Make Nanostructures. Nano scale Bio-structures, modelling

**UNIT - IV**

**Nano-Biotechnology:** Bio-molecules; Biosensors; Nanomaterials in drug delivery; Working in clean room environments; Safety and related aspects of Nanomaterials;

**UNIT – V**

**Carbon Nanomaterials and Applications:** Carbon Nano structures and types of Carbon Nano tubes, growth mechanisms of carbon nanotubes. Carbon clusters and Fullerenes, Lithium & Hydrogen adsorption & storages, Fuel cell applications and energy storage, Chemical Sensors applications of CNTs

**TEXT BOOKS AND REFERENCES:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanotechnology Fundamentals and Applications- by Manasi Karkare I. K International
4. Nanoscience and Nanotechnology in engineering – by Vijay K Varadan A Sivathanu pillai Word scientific
5. Nanotechnology Applications To Telecommunications And Networking By Daniel Minoli, Wiley Interscience
6. Nanotechnology Principles and Applications by Sulabha Kulkarni

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
SYNTHESIS OF NANOMATERIALS  
(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: NT832OE**

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**Course Objectives:**

- To provide knowledge about top-down and bottom-up approaches for the synthesis of nanomaterials.
- To enhance the various nanosynthesis techniques and to identify and solve problems
- To design and conduct experiments relevant to nanochemistry, as well as to analyze the results.
- To improve usage of synthesis methods for modern technology

**Course Outcome:** To provide abundant knowledge on various synthesis methods of nanomaterials.

**UNIT - I**

Introduction, Bottom-up approach: Sol-gel method, emulsion and Top-down: ball milling approach with examples.

**UNIT - II**

Physical methods: Inert gas condensation, Arc discharge, plasma synthesis, electric explosion of wires, molecular beam epitaxy, Physical Vapour Deposition, thermal evaporation, lithography and sputtering.

**UNIT - III**

Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, co-precipitation method. Semiconductor nanocrystals by arrested precipitation, sonochemical routes

**UNIT - IV**

Biological methods – use of bacteria, fungi, actinomycetes for nano-particle synthesis nano-particles Solvated metal atom dispersion, Template based synthesis of nanomaterials.

**UNIT - V**

Thermolysis route - spray pyrolysis, solvothermal and hydrothermal routes, solution combustion synthesis, Chemical vapor deposition



**TEXTBOOKS:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B .Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanostructures and Nanomaterials by Guozhong Cao
4. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
6. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
7. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J.Murray

**REFERENCE BOOKS:**

1. Encyclopedia of Nanotechnology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Science and Nanotechnology – by T. Pradeep, Tata McGraw Hill

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
CHARACTERIZATION OF NANOMATERIALS  
(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: NT833OE**

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**Course Objectives:**

- To develop ability to understand modern characterization techniques especially utilized to probe in nanoscopic regime
- To elucidate on application of standard spectroscopy, microscopy techniques for element analysis, structure analysis, depth profiling, topography imaging, as well as surface and interface analysis
- To provide overview of principles underlying the characterization methods and basic theory for analysis of the data obtained from the instrument
- The objective of this course is to make the students understand the principles underlying various spectroscopies and instrumentations specific to nanomaterials

**UNIT - I**

**Fundamentals of Electron Microscopy:** Advantages of Electron Microscope over Optical Microscope (Magnification, Resolution, Depth of field). Theory and principle of Electron Microscope, Electron sources, Electron lenses (Electrostatic and Electromagnetic).

**UNIT - II**

**Scanning Electron Microscopy: SEM:** Theory of operation, Specimen-Beam interactions Importance of beam spot size, Machine variables, Scanning Electron Microscope (SEM). **Specimen Preparation in SEM:** Special methods for various sample types – Biological sample preparation, Applications of SEM

**UNIT - III**

**Transmission Electron Microscopy: TEM:** Theory of operation, Modes of operation, Transmission Electron Microscope (TEM), Bright field Imaging, Electron diffraction, Dark field imaging, High Resolution TEM (HRTEM), Applications of TEM.

**UNIT - IV**

**Atomic Force Microscopy: AFM:** Basic concepts – Interactive forces, Principle and instrumentation, Force curves and force measurements, Modes of imaging: Tapping, contact and non-contact, Probes, Tip functionalization,

**UNIT - V****X-Ray Diffraction and Spectroscopic methods:**

X-ray diffraction–Powder method, Single crystal diffraction technique -Determination of crystal structures – Nanostructural analysis – Profile analysis (peak broadening and micro strain) – Crystallite size analysis using Scherer formula and Williamson – Hall equation. UV Spectroscopy, IR Spectroscopy and Raman Spectroscopy

**TEXT BOOKS:**

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni – Capital Publishing Company
2. 2. Nano: The Essentials – Understanding Nanoscience and Nanotechnology by T. Pradeep. Tata McGraw Hill
3. 3. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens, Wiley India Pvt Ltd.
4. A practical approach to X-Ray diffraction analysis by C. Suryanarayana

**REFERENCES:**

1. Haynes. R, Woodruff. D. P. and Talchar, T.A., optical Microscopy of Materials Cambridge University press, 1986.
2. Flegler, S.L., Heckman, J.W. and Klomparens, K.L., scanning and Transmission Electron Microscopy: A Introduction WH Freeman & Co, 1993.
3. Paul E. West, introduction to Atomic Force Microscopy Theory Practice Applications
4. Julian Chen N, C., introduction to Scanning Tunneling Microscopy, Oxford University Press, Inc., 1993.
5. Magonov, S.M., and Whangbo, M-H., surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis VCH Publishers, Inc., New York 1996.
6. Goldstein, J., Newbury, D.E., Joy, D.C., and Lym, C.E., scanning Electron Microscopy and X-ray Microanalysis, 2003.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**ANALOG AND DIGITAL IC APPLICATIONS**  
**(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT5110E**

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**UNIT - I**

**Integrated Circuits :** Classification, chip size and circuit complexity, basic information of Op amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

**OP-AMP Applications:** Basic application of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, sample & hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators.

**UNIT - II**

Schmitt trigger, Multivibrators, introduction to voltage regulators, features of 723.

**Active Filters & Oscillators:** Introduction, 1st order LPF, HPF filters. Band pass, Band reject, and all pass filters. Oscillator types and principle of operation – RC, Wien, and quadrature type, waveform generators – triangular, saw tooth, square wave and VCO.

**UNIT - III**

**Timers & Phase Locked Loops:** Introduction to 555 timer, functional diagram, monostable and astable operations, and applications, Schmitt Trigger. PLL - introduction, block schematic, principles, and description of individual blocks of 565.

**D-A and A- D Converters :** Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC specifications.

**UNIT - IV**

Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Design using TTL-74XX & CMOS 40XX series, code converters, decoders, Demultiplexers, decoders, & drives for LED & LCD display. Encoder, priority Encoder, multiplexers, & their applications, priority generators/checker circuits. Digital arithmetic circuits-parallel binary adder/subtractor circuits using 2's, Complement system. Digital comparator circuits.

## **UNIT - V**

**Sequential Circuits:** Flip-flops & their conversions. Design of synchronous counters. Decade counter, shift registers, & applications, familiarities with commonly available 74XX & CMOS 40XX series of IC counters.

**Memories:** ROM architecture, types, & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

### **TEXT BOOKS:**

1. Linear Integrated Circuits –D. Roy Choudhury, New Age International (p) Ltd, 2nd Ed., 2003.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

### **REFERENCES:**

1. Operational Amplifiers & Linear Integrated Circuits – R.F. Coughlin & Fredrick F. Driscoll, PHI, 1977.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco, McGraw Hill, 3rd Ed., 2002.
4. Digital Fundamentals – Floyd and Jain, Pearson Education, 8th Edition, 2005.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**INTELLECTUAL PROPERTY RIGHTS**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT512OE**

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**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights, and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing company ltd.,

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**COMPUTER ORGANIZATION**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT513OE**

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**Course Objectives:**

- To understand basic components of computers.
- To understand the architecture of 8086 processor.
- To understand the instruction sets, instruction formats and various addressing modes of 8086.
- To understand the representation of data at the machine level and how computations are performed at machine level.
- To understand the memory organization and I/O organization.
- To understand the parallelism both in terms of single and multiple processors.

**Course Outcomes:**

- Able to understand the basic components and the design of CPU, ALU and Control Unit.
- Ability to understand memory hierarchy and its impact on computer cost/performance.
- Ability to understand the advantage of instruction level parallelism and pipelining for high performance Processor design.
- Ability to understand the instruction set, instruction formats and addressing modes of 8086.
- Ability to write assembly language programs to solve problems.

**UNIT - I**

**Digital Computers:** Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

**Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description.

**Micro Programmed Control:** Control memory, Address sequencing, micro program example, design of control unit.

**UNIT - II**

**Central Processing Unit:** The 8086 Processor Architecture, Register organization, Physical memory organization, General Bus Operation, I/O Addressing Capability, Special Processor Activities, Minimum and Maximum mode system and timings.

8086 Instruction Set and Assembler Directives-Machine language instruction formats, Addressing modes, Instruction set of 8086, Assembler directives and operators.

### **UNIT - III**

Assembly Language Programming with 8086- Machine level programs, Machine coding the programs, Programming with an assembler, Assembly Language example programs.

Stack structure of 8086, Interrupts and Interrupt service routines, Interrupt cycle of 8086, Interrupt programming, Passing parameters to procedures, Macros, Timings and Delays.

### **UNIT - IV**

**Computer Arithmetic:** Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating - point Arithmetic operations.

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input –Output Processor (IOP), Intel 8089 IOP.

### **UNIT - V**

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

**Multi Processors:** Characteristics of Multiprocessors, Interconnection Structures, Inter processor arbitration, Inter processor communication, and synchronization.

### **TEXT BOOKS:**

1. Computer System Architecture, M. Moris Mano, Third Edition, Pearson. (**UNITS- I , IV , V**)
2. Advanced Microprocessors and Peripherals, K M Bhurchandi, A.K Ray ,3<sup>rd</sup> edition, McGraw Hill India Education Private Ltd. (**UNITS - II, III**).

### **REFERENCES:**

1. Microprocessors and Interfacing, D V Hall, SSSP Rao, 3<sup>rd</sup> edition, McGraw Hill India Education Private Ltd.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5<sup>th</sup> Edition, Tata McGraw Hill, 2002
3. Computer Organization and Architecture, William Stallings, 9th Edition, Pearson.
4. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4<sup>th</sup> Edition, Elsevier, 2009.



**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**DATA STRUCTURES**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**

**L T P C**

**Course Code: EM614PE/MT621OE**

**3 0 0 3**

**Course Objectives:**

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

**Course Outcomes:**

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

**UNIT - I**

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega, and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations-Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

**UNIT - II**

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.

**UNIT - III**

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals - DFS and BFS.

**UNIT - IV**

Searching - Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

**UNIT - V**

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees. Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

**TEXT BOOKS:**

1. Fundamentals of Data structures in C, 2<sup>nd</sup> Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D. S. Kushwaha and A.K. Misra, PHI.

**REFERENCE BOOKS:**

1. Data structures: A Pseudo code Approach with C, 2<sup>nd</sup> edition, R. F. Gilberg And B. A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2<sup>nd</sup> edition, M. A. Weiss, Pearson.
3. Data Structures using C, A.M. Tanenbaum, Y. Langsam, M. J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2<sup>nd</sup> edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2<sup>nd</sup> Edition, Narsimha Karumanchi, Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipschutz, Schaum's Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2<sup>nd</sup> edition, Pearson..
9. Data Structures using C & C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2<sup>nd</sup> edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**ARTIFICIAL NEURAL NETWORKS**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: MT622OE**

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**Course Objectives:**

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

**Course Outcomes:** By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

**UNIT - I**

**Introduction:** A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

**Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

**UNIT - II**

**Single Layer Perceptron:** Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

**Multilayer Perceptron:** Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

**UNIT - III**

**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

**UNIT - IV**

**Self-Organization Maps (SOM):** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

**UNIT - V**

**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

**Hopfield Models** – Hopfield Models, Computer Experiment

**TEXT BOOKS:**

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**INDUSTRIAL MANAGEMENT**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: MT623OE**

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**UNIT - I**

**Introduction to Management:** Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

**UNIT - II**

**Designing Organizational Structures:** Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

**UNIT - III**

**Operations Management:** Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production),-Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)

Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

**UNIT - IV**

**Work Study:** Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

**Statistical Quality Control:** variables-attributes, Shewart control charts for variables-  $\bar{X}$  chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

**UNIT - V**

**Job Evaluation:** methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

**Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path,

Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

**TEXT BOOKS:**

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers
2. Industrial Engineering and Management Science/T.R. Banga and S. C. Sarma/Khanna Publishers

**REFERENCE BOOKS:**

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons Work Study by ILO
2. Human factors in Engineering & Design/Ernest J McCormick / TMH
3. Production & Operation Management /Paneer Selvam /PHI
4. Industrial Engineering Management/NVS Raju/Cengage Learning
5. Industrial Engineering Hand Book /Maynard
6. Industrial Engineering Management / Ravi Shankar/ Galgotia

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**RENEWABLE ENERGY SOURCES**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**

**L T P C**

**Course Code: MT831OE/ME853PE**

**3 0 0 3**

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO<sub>2</sub> reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### **UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

#### **UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection.

#### **REFERENCE BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.



**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**PRODUCTION PLANNING AND CONTROL**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**

**L T P C**

**Course Code: MT832OE/ME854PE**

**3 0 0 3**

**Pre-requisites:** Management Science & Productivity.

**Course Objectives:** Understand the importance of Production planning & control. Learning way of carrying out various functions it so as to produce right product, right quantity at right time with minimum cost.

**Course Outcomes:** At the end of the course, the student will be able to, Understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

**UNIT – I**

**Introduction:** Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

**Forecasting** – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

**UNIT – II**

**Inventory management** – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning** – Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

**UNIT – III**

**Line Balancing:** Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

**UNIT – IV**

**Scheduling** –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling – job shop scheduling, line of balance (LOB) – objectives - steps involved.

**UNIT – V**

**Dispatching:** Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**Follow up:** definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

**TEXT BOOKS:**

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

**REFERENCE BOOKS:**

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)  
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES  
(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: CE833OE**

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**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**

Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.

Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**

Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**

Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**

Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**

Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**

1. Entrepreneurship Development and Small Business Enterprises, Poornima M.Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D.F.Kuratko and T.V.Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING**  
**MATERIAL CHARACTERIZATION TECHNIQUES**  
**(OPEN ELECTIVE –I)**

**B.Tech. III Year I Sem.**  
**Course Code: MM5110E**

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**Course Objective:** This course is intended to give an exposure to evaluation of special characteristics of materials (Structural, Mechanical & Thermal etc.) in order to understand their suitability in Engineering Applications

**Course Outcome:** At the end of the course the student will be able to characterize, identify, and apply the material to the concerned application.

**UNIT-I**

**X-Ray Diffraction:** Introduction, Production and properties of x-rays, Bragg's law of diffraction. Experimental Methods of Diffraction, Intensity of Diffracted beams - Scattering by an electron by an atom, by a unit cell, structure-factor calculations; factors affecting Diffraction Intensities.

**Application of XRD:** Orientation of single crystals, Effect of plastic deformation, the structure of polycrystalline Aggregates, Determination of crystal structure, Precise lattice parameter measurements, Phase - diagram determination, Order-disorder transformation, Chemical analysis by Diffraction, Stress measurement

**UNIT-II**

**Elements of Quantitative Metallography and Image Processing.**

**Scanning Electron Microscopy:** Principle, Interaction of electron beams with matter, Construction and Working principle Scanning Electron Microscopy, Working Distance, Depth of field, Depth of focus and Spot Size, Specimen preparation for Scanning Electron Microscopy, Different types of modes used in Scanning Electron Microscopy (Secondary Electron and Backscatter Electron) and their applications, Advantages, limitations and applications of Scanning Electron Microscopy, Electron Backscattered Diffraction.

**UNIT-III**

**Transmission Electron Microscopy:** Principle, Construction and Working principle of Transmission Electron Microscopy, Resolving power and Magnification, Depth of field and Depth of focus, Bright and dark field, Specimen preparation for the Transmission Electron Microscopy: Selected Area Diffraction, Applications of Transmission Electron Microscopy, Advantage and Limitations of Transmission Electron Microscopy.

**UNIT-IV**

**Spectroscopy – Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy, Electron Probe Microanalyzer,**

**UNIT-V**

Principles, Instrumentation, operation and application of thermal analysis, Thermogravimetric Analysis, TGA, Differential Scanning Calorimetry, Differential thermal analysis, Dynamic Mechanical Analysis, Dilatometry.

**TEXT BOOKS:**

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

**REFERENCES:**

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall , 2001 – Science

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING  
SCIENCE AND TECHNOLOGY OF NANO MATERIALS  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: MM621OE**

**L T P C**  
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**Course Objective:** This course is intended to expose the students to the most exciting area of nano materials. This would emphasize the classification, synthesis and applications of these materials.

**Course Outcome:** The student will be able to design a component/material that would provide us a 'better tomorrow' via nanotechnology.

**UNIT-I**

Introduction: History and Scopy, classification of nanostructural materials, Applications, Challenges and future prospects

**UNIT-II**

Unique properties of nano-materials, microstrucutre and defects in nano-crystalline materials, effect of nano-dimension on material behaviours

**UNIT-III**

Synthesis Routes: Bottom up approaches, top down approaches, consolidation of nano-powders.

**UNIT-IV**

Application of nano-materials: Nano-electronics, Micro and Nano-electromechanical systems, nano-sensors, Nano-catalyst, Structure and engineering, Automotive, Nano-medical, water and environment treatment, energy, defence and space, textile and paints.

**UNIT-V**

Nanostructured materials with high application potential: Quantum dots, Carbon nanotubes, GaN Nanowires, Nanocrystalline Zno, Nanocrystalline Tio<sub>2</sub>, Multilayered films

**TEXT BOOKS:**

1. Text book of Nano Science and Technology: B S Murthy, Universities press-IIM series in Metallurgy and Material Sciene
2. Nano Essentials: T Pradeep / TMH

**REFERENCES:**

1. Springer Handbook of Nanotechnology
2. Nano Materials Synthersis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandyopadyay/ New age Publications

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING  
METALLURGY FOR NON METALLURGISTS  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: MM622OE**

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**Course Objectives:**

- To describe the basic principles of metallurgy and the importance of metallurgy in various discipline of engineering.
- Gain a thorough knowledge about heat treatment of steels.
- Gain knowledge about properties and uses of cast irons and non ferrous metals.
- Gain a working knowledge of basic testing methods for metals.

**Course Outcomes:** At the end of the course Student would be able

- To use and apply metallurgy in his own branch of engineering.
- The student will be able to justify the various testing methods adopted for metals.

**UNIT-I**

**Introduction:** Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels

**UNIT-II**

**Heat Treatment of Steels:** The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering

**UNIT-III**

**Cast irons:** Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

**UNIT-IV**

**Non Ferrous Metals:** Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys

**UNIT-V**

**Testing of Metals:** Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

**TEXT BOOKS:**

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997
3. Mechanical Metallurgy – G. E. Dieter



**REFERENCES:**

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006
3. Foundations of Materials Science and Engineering – WF Smith

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING  
DESIGN AND SELECTION OF ENGINEERING MATERIALS  
(OPEN ELECTIVE - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: MM831OE**

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**Course Objective:** This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

**Course Outcome:** Understand the Relationship between materials selection, processing and applications.

**UNIT-I**

**Materials selection process:** Criteria for selection of materials

**UNIT-II**

**Effect of composition, processing and structure on materials properties:** Concepts in the design of industrial components

**UNIT-III**

**Properties vs Performance materials:** Aerospace and defense applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, Intermetallics, Aluminides

**UNIT-IV**

**Nuclear Material: Manufacturing aspects of design**

Nuclear application: radiation damage, effect of radiation damage on YS, UTS, DBTT, design of alloy for fission and fusion reactors

**UNIT-V**

**Special Materials: Manufacturing aspects of design**

Selection and design of ceramics composites and polymers for specific applications,

**TEXT BOOKS**

1. M.F. Ashby, *Materials Selection in Mechanical Design*, Pergamon Press, 1992
2. G.E. Dieter, *Engineering Design, A Materials and Processing Approach*, 2nd ed., McGraw-Hill, 1991

**REFERENCES**

1. T.H. Courtney, *Mechanical Behavior of Materials*, McGraw-Hill, 1990
2. J.R. Dixon and C. Poli, *Engineering Design and Design for Manufacturing*, Field Stone Publishers, 1995

**B.TECH. MINING ENGINEERING**  
**INTRODUCTION TO MINING TECHNOLOGY**  
**(Open Elective - I)**

**B.Tech. III Year I Sem**  
**Course Code: MN511OE**

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**Course Objectives:** The student is expected to learn the fundamentals of mining engineering so as to encourage multi-disciplinary research and application of other branches of engineering to mining technology.

**Course Outcomes:** Upon completion of the course, the student shall be able to understand various stages in the life of the mine, drilling , blasting and shaft sinking.

**UNIT-I**

Introduction: Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology,

**UNIT-II**

Stages in the life of the mine - prospecting, exploration, development, exploitation, and reclamation. Access to mineral deposit- selection, location, size and shape (incline, shaft and adit), brief overview of underground and surface mining methods.

**UNIT-III**

Drilling: Types of drills, drilling methods, electric, pneumatic and hydraulic drills, drill steels and bits, drilling rigs, and jumbos.

**UNIT-IV**

Explosives: Classification, composition, properties and tests, fuses, detonators, blasting devices and accessories, substitutes for explosives, handling and storage, transportation of explosives.; Rock blasting: Mechanism of rock blasting, blasting procedure, and pattern of shot holes.

**UNIT-V**

Shaft sinking: Ordinary and special methods, problems, and precautions, shaft supports and lining.

**TEXT BOOKS:**

1. R. P. Pal, Rock blasting effect and operation, A. A. Balkema, 1<sup>st</sup> Ed, 2005.
2. D. J. Deshmukh, Elements of mining technology, Vol. 1, Central techno, 7<sup>th</sup> Ed, 2001

**REFERENCE BOOKS:**

1. C. P. Chugh, Drilling technology handbook, Oxford and IBH, 1<sup>st</sup> Ed, 1977.
2. R. D. Singh, Principles and practices of modern coal mining, New age international, 1<sup>st</sup> Ed, 1997.

**B.TECH. MINING ENGINEERING**  
**COAL GASIFICATION, COAL BED METHANE AND SHALE GAS**  
**(Open Elective - II)**

**B.Tech. III Year II Sem**  
**Course Code: MN621OE**

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| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**Course Objectives:** To specialize the students with additional knowledge on geological and technological factors of coal gasification industry mining methods of underground coal gasification, linkage techniques etc.

**Course Outcomes;** Student can get specialized in the underground coal gasification concepts, application and future scope in various geomining conditions.

**UNIT-I**

Underground Coal Gasification (UCG) Concept; Chemistry, conditions suitable for UCG, Principles of UCG., Merits and Demerits.

**UNIT-II**

UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG.

**UNIT-III**

Mining methods of UCG: Chamber method, Stream method, Borehole procedure method, Blind bore hole method.

**UNIT-IV**

Non-Mining methods of UCG: Level seams, Inclined seams.

**UNIT-V**

Linkage Techniques: Pekcolation linkage, Electro linkage, Boring linkage, compressed-air-linkage, Hydraulic fracture linkage. Future Scope and Development: Innovations.

**TEXT BOOKS:**

1. Underground Coal Mining Methods – J.G. SINGH
2. Winning and Working Coal in India Vol.II- R. T. Deshmukh and D.J.Deshmukh.

**REFERENCE BOOK:**

1. Principles and Practices of Modern Coal Mining – R.D. SINGH

**B.TECH. MINING ENGINEERING**  
**SOLID FUEL TECHNOLOGY**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: MN831OE**

| L | T | P | C |
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**Pre-requisites:** Under graduate Physics and Chemistry

**Course Objectives:** Understand coal formation, properties, and their evaluation along with various issues of coal washing

**Course Outcomes:** Students can understand the fundamentals of Processes of formation of coal, properties and evaluation and coal preparation and washability characteristics of coal

**UNIT-I**

Introduction: Processes of formation of coal, Theories of origin of coal, Eras of coal formation, Indian Coalfields and its subsidiaries: Occurrence and distribution, coal bearing formations, coal type and rank variation, Characteristics of major coalfields, Coal production from different sectors.

**UNIT-II**

Coal petrography: Macro and micro lithotypes, Composition of macerals, application of coal petrography, Mineral matter in coal: Origin and chemical composition, Impact of mineral matter in coal process industry.

**UNIT-III**

Coal properties and their evaluation: proximate and ultimate analysis, calorific value, crossing and ignition point temperature, plastic properties (free swelling index, Caking index, Gray King Low Temperature Assay, Roga index, plastometry, dilatometry).

**UNIT-IV**

Physical properties like specific gravity, hard groove grindability index, heat of wetting, crossing point temperature of coal, Behavior of coal at elevated temperatures and products of thermal decomposition, Classification of coal - International and Indian classification, grading of Indian coals.

**UNIT-V**

Coal Washing: Principles, objectives, coal preparation, washability characteristics; Selection, testing, storage and utilization of coking and non-coking coal, Use of coal by different industries.

**TEXT BOOKS:**

1. S. Sarkar, Fuels and Combustion, Orient Longman Private Ltd., 2<sup>nd</sup> edition, 1990
2. O. P. Gupta, Elements of Fuels, Furnaces and Refractories, Khanna Publication, 3<sup>rd</sup> Edition, 1996.

**REFERENCE BOOKS:**

1. M. A. Elliot, Chemistry of Coal Utilization, Wiley, 1981.
2. D. Chandra, R. M. Singh, and M. P. Singh, Text Book of Coal, Tara Book Agency, 2000.

**B.TECH. MINING ENGINEERING  
HEALTH AND SAFETY IN MINES  
(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: MN832OE**

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|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**Course Objectives:** To brief mining students in health and safety engineering concepts, causes of accident, training, human behavioral approach in safety etc.

**Course Outcomes:** student will gain knowledge and able to understand the importance of health and safety including the role of safety risk assessment in mining industry

**UNIT-I**

Introduction to accidents, prevention, health and safety in industry : Terminology, reason for preventing accidents – moral and legal.

Safety scenario in Indian mines, Accidents in Indian mines, Measurement of safety performance. Classification of accidents as per Mining legislation/law and general classification of accidents.

**UNIT-II**

Causes and preventive measures of accidents in underground and opencast mines i.e., due to fall of roof and sides, transportation of machinery, haulage and winding, drilling and blasting, movement of machinery in opencast mines and electricity etc., ; accident analysis and report, cost of accidents, statistical analysis of accidents and their importance for promotion of safety.

**UNIT-III**

System engineering approach to safety, techniques used in safety analysis, generic approach to loss control within mining operations. Concept of ZAP and MAP.

**UNIT-IV**

Risk management, Risk identification, Risk estimation and evaluation, Risk minimization techniques in mines. Risk analysis using FTA, HAZOP, ETA etc; health risk assessment and occupational diseases in mining.

**UNIT-V**

Development of safety consciousness, publicity and propaganda for safety; training of workmen, Human Behavioral approach in safety, safety polices and audio-visual aids, safety drives campaigns, safety audit. Safety management and organization; Internal safety organization

**TEXT BOOKS:**

1. Occupational Safety and Health in Industries and Mines by C.P. Singh
2. S.K. Das, Mine Safety and Legislation. Lovely Prakashan, Dhanbad, 2002

**REFERENCE BOOKS:**

1. N.J. Bahr, System Safety Engineering, and Risk Assessment: A Practical Approach, Taylor and Francis, NY, 1997.
2. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad



**B.TECH. PETROLEUM ENGINEERING  
MATERIALS SCIENCE AND ENGINEERING  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: PE511OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** This subject is intended to:

- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Import expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- To gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

**Course Outcome:** After the course, the students will be to

- Equipped with knowledge to prepare material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures.

**UNIT - I**

Classification of engineering materials, Levels of Structure, Structure-Property relationships in materials, Crystal Geometry and non-crystalline(amorphous) states. Lattice –Bravais lattices, crystal systems with examples. Lattice co-ordinates, Miller and Miller- Bravais Indices for directions and planes: ionic, covalent and metallic solids; packing factors and packing efficiency, ligancy and coordination number. Structure determination by Brag's X-ray diffraction method.

**UNIT - II**

Crystal Imperfections-classification-point defects-estimation of point defects-Dislocations-classification(edge and screw)-surface defects -dislocation motion and its relevance to mechanical and chemical properties –stress-strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-elastic and plastic deformation-slip -stress required to move a dislocation. Multiplication of dislocations – dislocation reactions, effect on mechanical behavior of materials. Strain hardening/work hardening –dynamic recovery and recrystallization.

**UNIT - III**

Fracture and failure of materials: ductile fracture analysis-brittle fracture analysis-fracture toughness-ductile-brittle transition-fatigue fracture-theory, creep and mechanism –methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

**UNIT - IV**

Solid –liquid and solid-solid Equilibria for metals and alloys. Phase rule-phase diagram for pure metals (single component system),alloys(binary systems)-micro structural changes during cooling-Lever rule and its applications-typical phase diagrams-homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures- non-equilibrium cooling. Binary Systems(phase diagrams) for study: Cu-Ni/Bi-Cd/Pb-Sn/ Fe-C /Al-Cu  
Materials for chemical and petrochemical industrial process equipment- Effect of alloying on mechanical and chemical behavior of materials, applications of heat treatment methods for strengthening of engineering materials.

**UNIT - V**

Composite structures and their advantages over conventional materials–Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement-applications –Nano materials –synthesis and characterization.  
Stability criteria of materials in chemical/petrochemical industrial environments. Corrosion and Oxidation of materials –basic mechanisms-types of corrosion, Corrosion testing and evaluation Prevailing methods to combat corrosion. Coatings –metallic non-metallic, passivity, cathodic protection.

**TEXT BOOKS:**

1. Materials Science and Engineering, Raghavan, V., 5<sup>th</sup> Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith, and Javed Hashemi, 4<sup>th</sup> Edition, Tata-McGraw Hill, 2008.

**REFERENCE BOOKS:**

- 1 Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6<sup>th</sup> Edition, Pearson, 2002.
- 2 Materials Science and Engineering, Balasubramaniam, R., Callister's, Wiley, 2010.
- 3 Corrosion Engineering, Mars G. Fontana, Tata-McGraw Hill, 2005.

**B.TECH. PETROLEUM ENGINEERING**  
**RENEWABLE ENERGY SOURCES**  
**(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: PE512OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO<sub>2</sub> reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### **UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

#### **UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection.

#### **REFERENCE BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

**B.TECH. PETROLEUM ENGINEERING  
ENVIRONMENTAL ENGINEERING  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: PE513OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** This subject provides the knowledge of water sources, water treatment, design of distribution system waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

**Course Outcomes:** At the end of the course, the student will be able to:

- Analyze characteristics of water and wastewater
- Estimate the quantity of drinking water and domestic wastewater generated
- Design components of water supply systems Design sewerage system

**UNIT – I**

Introduction: Waterborne diseases – protected water supply – Population forecasts, design period – types of water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards: sources of water - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

**UNIT – II**

Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants - feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation - comparison of filters – disinfection – theory of chlorination, chlorine demand - other disinfection practices- Miscellaneous treatment methods.

**UNIT – III**

Distribution systems requirement –method and layouts -Design procedures- Hardy Cross and equivalent pipe methods pipe – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house - Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow

**UNIT - IV**

characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials – sewer appurtenances manholes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses – house drainage – components requirements – sanitary fittings-traps – one pipe and two pipe systems of plumbing – ultimate disposal of sewage – sewage farming – dilution.

## **UNIT – V**

Waste water treatment plant – Flow diagram - primary treatment Design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – Biological treatment – trickling filters – standard and high rate – Construction and design of oxidation ponds. Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks working principles and design – soak pits.

### **TEXT BOOKS:**

1. Environmental Engineering by H.S Peavy, D. R. Rowe, G. Tchobanog lous, McGraw Hill Education (India) Pvt Ltd, 2014
2. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.
3. Water Supply & Environmental Engineering by A.K. Chatterjee.
4. Water Supply and sanitary Engineering by G.S. Bindi, Dhanpat Rai & Sons Publishers.

### **REFERENCES:**

1. Water and Waste Water Technology by Steel, Wiley
2. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.
3. Water and Waste Water Engineering by Fair Geyer and Okun, Wiley, 2011
4. Water and Waste Water Technology by Mark J Hammar and Mark J. Hammar Jr.Wiley, 2007.

**B.TECH. PETROLEUM ENGINEERING**  
**ENERGY MANAGEMENT AND CONSERVATION**  
**(Open Elective - II)**

**B.Tech. III Year II Sem.**  
**Course Code: PE621OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** To acquaint the student with the conventional energy sources and their utilization. To understand the importance of heat recovery and energy conservation methods and energy audit.

**Course Outcomes:** Students would have a good knowledge about conventional energy sources and their audit. Ability to apply the fundamentals of energy conservation and management.

**UNIT-I**

Global & Indian Energy Scenario-Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns , Basics of Energy and its various forms.

**UNIT-II**

Energy Audit: Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. Material and Energy balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams,

**UNIT-III**

Energy Action Planning, Financial Management: Financial analysis techniques- Risk and sensitivity analysis- Financing options, Energy performance contracts and role of ESCOs- Energy Monitoring and Targeting: Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

**UNIT-IV**

Building Envelope – principles of analysis – Envelope performance -Envelope analysis of Existing and new buildings – Building standards for new and Existing constructions. HVAC Systems types – Energy conservation opportunities – cooling equipment – Domestic hot water Estimating HVAC Energy consumption.

**UNIT-V**

Principles of Electric Energy Management, Energy Management control systems – Energy systems maintenance. Energy management in water and waste water treatment – solid waste treatment- air pollution control systems .

Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration – Waste Heat recovery. Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act.

**TEXT BOOKS:**

1. Energy Management by Murfy
2. General Aspects of Energy Management and Audit, National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

**REFERENCE BOOKS:**

1. Energy Management Handbook, W.C. Turner, 5<sup>th</sup> Edition, Marcel Dekker, Inc, New York, 2005.
2. Guide to Energy Management, B. L. Capehart, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.
3. Energy Management by O.P. Collagan



**B.TECH. PETROLEUM ENGINEERING  
OPTIMIZATION TECHNIQUES  
(Open Elective - II)**

**B.Tech. III Year II Sem.**  
**Course Code: PE622OE**

**L T/P/D C**  
**3 0/0/0 3**

**Prerequisite:** Mathematics –I & Mathematics –II

**Course Objectives:**

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

**Course Outcomes:** After completion of this course, the student will be able to

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

**UNIT – I**

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**

**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems.

### UNIT – III

**Unconstrained Nonlinear Programming:** One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques:** Univariate method, Powell’s method and steepest descent method.

### UNIT – IV

**Constrained Nonlinear Programming:** Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

### UNIT – V

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

### TEXT BOOKS:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4<sup>th</sup> edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

### REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in operations research 3<sup>rd</sup> edition, 2003.
2. H.A. Taha, “Operations Research: An Introduction”, 8<sup>th</sup> Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, “Optimization for Engineering Design – Algorithms and Examples”, PHI Learning Pvt. Ltd, New Delhi, 2005.

**B.TECH. PETROLEUM ENGINEERING**  
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: PE623OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**

Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.

Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**

Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**

Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**

Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**

Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. PETROLEUM ENGINEERING  
DISASTER MANAGEMENT  
(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: PE831OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** The subject provides different disasters, tools, and methods for disaster management.

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

**UNIT - II**

**Disaster Management Mechanism:** Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

**UNIT - III**

**Capacity Building:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

**UNIT - IV**

**Coping with Disaster:** Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

**UNIT - V**

**Planning for disaster management:** Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

**TEXT BOOKS:**

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (<http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf>)

**B.TECH. PETROLEUM ENGINEERING**  
**FUNDAMENTALS OF LIQUEFIED NATURAL GAS**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: PE832OE**

**L T/P/D C**  
**3 0/0/0 3**

**Course Objectives:** The students will be able to:

- Gain basic knowledge of LNG and its prospective.
- Learn different liquefaction technologies of LNG.
- Have knowledge on different functional units on receiving terminals
- Analyze transportation of LNG and regasification.
- Understand HSE of LNG industry.

**Course Outcomes:** Upon successful completion of this course, the student will be able to:

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

#### **UNIT-I**

**Introduction:** Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

#### **UNIT-II**

**Liquefaction Technologies:** Propane precooled mixed refrigerant process – Description of Air products C<sub>3</sub>MR LNG process – Liquefaction – LNG flash and storage.

**Cascade process:** Description of ConocoPhillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.

**Other Liquefaction Processes:** Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and subcooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

#### **UNIT-III**

**Supporting Functional Units in LNG Plants:** Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulphur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

#### **UNIT-IV**

**Receiving Terminals:** Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions.

Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C<sub>2</sub><sup>+</sup> components.

**LNG Shipping Industry & Major Equipment in LNG Industry:** LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations

#### **UNIT-V**

**Major equipment in LNG industry:** Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressors. LNG pumps and liquid expanders – Loading Arms and gas turbines.

**Vaporizers:** Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.; LNG tanks.

**Safety, Security and Environmental Issues:** Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

#### **TEXT BOOK:**

1. LNG: Basics of Liquefied Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

([https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook\\_demos/lng/HTML/index.html](https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html).)

#### **REFERENCE BOOKS:**

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.



**B.TECH. PETROLEUM ENGINEERING**  
**HEALTH, SAFETY AND ENVIRONMENT IN PETROLEUM INDUSTRY**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: PE833OE**

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**Course Objectives:**

- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of Hazop in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/production installation/production platform.

**Course Outcomes:**

- The student can have the knowledge of various Acts related to safety, Health and environment in petroleum industry.
- The student can have the knowledge of various drilling fluids handling and safe disposal such toxic products.
- Knowledge of disaster management to fight any crisis.
- Knowledge of Hazard studies and occupational health hazards in the industry.

**UNIT - I**

**Introduction to environmental control in the petroleum industry:** Overview of environmental issues- A new attitude.

**Drilling and production operations:** Drilling- Production- Air emissions.

**UNIT - II**

**The impact of drilling and production operations:** Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.

**Environmental transport of petroleum wastes:** Surface paths- Subsurface paths- Atmospheric paths. Planning for Environmental protection.

**Waste treatment methods:** Treatment of water- Treatment of solids- Treatment of air emissions-Waste water disposal: surface disposal.

**UNIT - III**

**Oil mines regulations:** Introduction>Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous- Remediation of contaminated sites- Site assessment-Remediation process.

**UNIT- IV**

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

**UNIT - V**

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist)- Inspection & safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment- Suppression of hydrocarbons fires.

**TEXT BOOKS:**

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

**REFERENCE BOOKS:**

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3<sup>rd</sup> Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, McGraw Hill, 2014.