### JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

**LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR R16 B.TECH. ALL YEARS**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the Department Offering Open Electives</th>
<th>Open Elective – I (Semester – V)</th>
<th>Open Elective – II (Semester – VI)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Aeronautical Engg.</td>
<td>AE511OE: Introduction to Space Technology</td>
<td>AE621OE: Introduction to Aerospace Engineering</td>
</tr>
<tr>
<td>3</td>
<td>Biomedical Engg.</td>
<td>BM511OE: Reliability Engineering</td>
<td>BM621OE: Medical Electronics</td>
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<tr>
<td>S. No.</td>
<td>Name of the Department Offering Open Electives</td>
<td>Open Elective – III (Semester – VIII)</td>
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<tr>
<td>1</td>
<td>Aeronautical Engg.</td>
<td>AE831OE: Air Transportation Systems</td>
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<td>AE832OE: Rockets and Missiles</td>
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<tr>
<td>2</td>
<td>Automobile Engg.</td>
<td>AM831OE: Introduction to Mechatronics</td>
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<td></td>
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<td>AM832OE: Microprocessors and Microcontrollers</td>
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<tr>
<td>3</td>
<td>Biomedical Engg.</td>
<td>BM831OE: Telemetry and Telecontrol</td>
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<td>BM832OE: Electromagnetic Interference and Compatibility</td>
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<tr>
<td>4</td>
<td>Civil Engg.</td>
<td>CE831OE: Environmental Impact Assessment</td>
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<thead>
<tr>
<th>S. No.</th>
<th>Name of the Department Offering Open Electives</th>
<th>Open Elective – III (Semester – VIII)</th>
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<tbody>
<tr>
<td>12</td>
<td>Mechanical Engg. (Material Science and Nanotechnology)</td>
<td>NT511OE: Fabrication Processes</td>
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<tr>
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<td>NT512OE: Non destructive Testing Methods</td>
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<td></td>
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<td>NT513OE: Fundamentals of Engineering Materials</td>
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<td></td>
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<td>NT621OE: Introduction to Material Handling</td>
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<td></td>
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<td>NT622OE: Non-Conventional Energy Sources</td>
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<td>NT623OE: Robotics</td>
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<td>13</td>
<td>Mechanical Engg. (mechatronics)</td>
<td>MT511OE: Analog and Digital I.C. Applications</td>
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<td>MT512OE: Intellectual Property Rights</td>
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<td>MT513OE: Computer Organization</td>
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<td>MT621OE: Data Structures</td>
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<td>MT622OE: Artificial Neural Networks</td>
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<td>MT623OE: Industrial Management</td>
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<td>14</td>
<td>Metallurgical and Materials Engg.</td>
<td>MM511OE: Materials Characterization Techniques</td>
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<tr>
<td></td>
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<td>MM621OE: Science and Technology of Nano Materials</td>
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<td>MM622OE: Metallurgy of Non Metallurgists</td>
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<td>15</td>
<td>Mining Engg.</td>
<td>MN511OE: Introduction to Mining Technology</td>
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<td>MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas</td>
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<td>16</td>
<td>Petroleum Engg.</td>
<td>PE511OE: Materials Science and Engineering</td>
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<td>PE512OE: Renewable Energy Sources</td>
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<td>PE513OE: Environmental Engineering</td>
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<td>PE621OE: Energy Management and Conservation</td>
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<td>PE622OE: Optimization Techniques</td>
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<td>PE623OE: Entrepreneurship and Small Business Enterprises</td>
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<td>5</td>
<td>CE832OE</td>
<td>Optimization Techniques in Engineering</td>
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<td></td>
<td>CE833OE</td>
<td>Entrepreneurship and Small Business Enterprises</td>
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<td>CN831OE</td>
<td>Remote Sensing and GIS</td>
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<td>CE833OE</td>
<td>Entrepreneurship and Small Business Enterprises</td>
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<td>6</td>
<td>CS831OE</td>
<td>Linux Programming</td>
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<td>CS832OE</td>
<td>R Programming</td>
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<td>CS833OE</td>
<td>PHP Programming</td>
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<td>7</td>
<td>EC831OE</td>
<td>Electronic Measuring Instruments</td>
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<td>EM831OE</td>
<td>Data Analytics</td>
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<td>9</td>
<td>EE831OE</td>
<td>Entrepreneur Resource Planning</td>
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<td>EE832OE</td>
<td>Management Information Systems</td>
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<td>EE833OE</td>
<td>Organizational Behaviour</td>
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<td>10</td>
<td>EI831OE</td>
<td>Sensors and Transducers,</td>
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<td>EI832OE</td>
<td>PC Based Instrumentation</td>
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<td>11</td>
<td>ME831OE</td>
<td>Total Quality Management</td>
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<td></td>
<td>ME832OE</td>
<td>Industrial Safety, Health, and Environmental Engineering</td>
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<td>ME833OE</td>
<td>Basics of Thermodynamics</td>
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<td>ME834OE</td>
<td>Reliability Engineering</td>
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<tr>
<td>12</td>
<td>NT831OE</td>
<td>Concepts of Nano Science And Technology</td>
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<td></td>
<td>NT832OE</td>
<td>Synthesis of Nanomaterials</td>
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<td></td>
<td>NT833OE</td>
<td>Characterization of Nanomaterials</td>
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<td>13</td>
<td>MT831OE</td>
<td>Renewable Energy Sources</td>
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<td>MT832OE</td>
<td>Production Planning and Control</td>
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<td>CE833OE</td>
<td>Entrepreneurship and Small Business Enterprises</td>
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<tr>
<td>14</td>
<td>MM831OE</td>
<td>Design and Selection of Engineering Materials</td>
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<td>15</td>
<td>MN831OE</td>
<td>Solid Fuel Technology</td>
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<td>MN832OE</td>
<td>Health &amp; Safety in Mines</td>
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<td>16</td>
<td>PE831OE</td>
<td>Disaster Management</td>
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<td></td>
<td>PE832OE</td>
<td>Fundamentals of Liquefied Natural Gas</td>
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<tr>
<td></td>
<td>PE833OE</td>
<td>Health, Safety and Environment in Petroleum Industry</td>
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</tbody>
</table>

*Open Elective* – Students should take Open Electives from 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.
B.TECH. AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNOLOGY
(OPEN ELECTIVE - I)

B.Tech. III Year I Sem.                                      L T P C
Course Code: AE511OE                                      3 0 0 3

UNIT - I

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:

REFERENCES
1. ‘Rocket Propulsion and Space flight dynamics’, Cornelisse JW, Schoyer HFR, and WakkerKF, Pitman, 1984
B.TECH. AERONAUTICAL ENGINEERING
INTRODUCTION TO AEROSPACE ENGINEERING
(OPEN ELECTIVE - II)

B.Tech. III Year II Sem.
Course Code: AE621OE

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:**

**REFERENCES**
UNIT- I

UNIT-II

UNIT- III

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:**


**REFERENCES:**

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

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

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  

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: Tsiolosky'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:

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

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

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.

**REFERENCES:**

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

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

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.
B.TECH. AUTOMOBILE ENGINEERING
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:**

**REFERENCE BOOKS:**
7. Data Structures, S. Lipscutz, Schaum’s Outlines, TMH.
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  

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 Pattern 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:

REFERENCE BOOKS:
1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligence, Li Min Fu TMH 2003
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.


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 , resetable 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.


UNIT – IV

UNIT – V

**TEXT BOOKS:**
2. Introduction to Mechatronics / Appukuttan /Oxford

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

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

TEXT BOOKS:

REFERENCE BOOKS:
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
B.TECH. BIOMEDICAL ENGINEERING
RELIABILITY ENGINEERING
(Open Elective – I)

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

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 irrepairable 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 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.

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.

TEXT BOOKS:

REFERENCE BOOK:
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:

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

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

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
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.

UNIT – III
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

TEXT BOOKS:
1. Telemetry Principles – D. Patranabis, TMH

REFERENCE BOOKS:
B.TECH. BIOMEDICAL ENGINEERING
ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY
(Open Elective – III)

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

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.

UNIT - II

UNIT - III
Shielding, Theory and Effectiveness, Materials, Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Effectiveness Measurements, Electrical Bonding.
UNIT – IV


UNIT - V

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

TEXT BOOKS:

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

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

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.

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

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

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

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:**

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

B.Tech. III Year II Sem

Course Code: CE622OE

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.

UNIT – I

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

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

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  L  T/P/D  C
Course Code: CE831OE  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.

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

TEXT BOOKS:

REFERENCES:
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
B.TECH. CIVIL ENGINEERING
OPTIMIZATION TECHNIQUES IN ENGINEERING
(Open Elective - III)

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

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-

UNIT - II
Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT - III
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

UNIT - V
Geometric Programming: Polynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P (≤ type only)

TEXT BOOKS:
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
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

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:

Units – 5: Strategic perspectives in Entrepreneurship:

Text Books:
REFERENCES:
1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
DISASTER MANAGEMENT
(Open Elective - I)

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

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 management.

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

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

B.Tech.III Year II Sem

Course Code: CN621OE

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.
- Indentify 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.

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

TEXT BOOKS:

REFERENCES:
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
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)

Course Code: CN831OE
Course Code: CN831OE

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

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:

REFERENCES:
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:
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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:

Units – 5: Strategic perspectives in Entrepreneurship:

TEXT BOOKS:
REFERENCES:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
OPERATING SYSTEMS
(OPENS ELECTIVE – I)

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

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
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 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
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.

TEXT BOOKS:

REFERENCE BOOKS:
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

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 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 database Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

UNIT - II

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**


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


**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.


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

**TEXT BOOKS:**

**REFERENCE BOOKS:**
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

Course Code: CS621OE

3 0 0 3

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.
3. Thinking in Java, Bruce Eckel, Pearson Education
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

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:

REFERENCE BOOKS:
1. The craft of software testing - Brian Marick, Pearson Education.
7. Software Testing, M.G.Limaye, TMH.
B.TECH COMPUTER SCIENCE AND ENGINEERING / B.TECH INFORMATION TECHNOLOGY
CYBER SECURITY
(OPEN ELECTIVE – II)

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

UNIT- I

UNIT - II

UNIT - III

UNIT IV

UNIT V
Cyber Security: Organizational Implications

TEXT BOOK:
REFERENCE BOOK:

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

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
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
UNIT- III
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 and fcntl system calls, Comparison of IPC mechanisms.

TEXT BOOKS:
1. Unix System Programming using C++, T. Chan, PHI.
3. Unix Network Programming, W. R. Stevens, PHI.

REFERENCE BOOKS:
6. Shell Scripting, S. Parker, Wiley India Pvt. Ltd.
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
(OPENS ELECTIVE – III)

B.Tech. IV Year II Sem.
Course Code: CS832OE

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

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


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.  L  T  P  C
Course Code: CS833OE  3  0  0  3

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:
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. L T P C
Course Code: EC511OE 3 0 0 3

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

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.
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:**
2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL EDUCATION, 1999

**Reference Books:**
2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
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

L T P C
3 0 0 3

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

UNIT - II

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 interference cards and PC cards, bridges, switches, switches Vs Routers.

TEXT BOOKS:

REFERENCE BOOKS:
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
L T P C

3 0 0 3

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

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
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:**

**REFERENCES:**
B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
SCRIPTING LANGUAGES
(Open Elective – I)

B.Tech. III Year I Sem.  
Course Code: EM511OE  
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: 

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, Evel, 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.

REFERENCE BOOKS:
B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
SOFT COMPUTING TECHNIQUES
(Open Elective – II)

B.Tech. III Year II Sem.
Course Code: EM621OE

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 Artifical 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:

UNIT –V:
Hybrid Systems:

TEXT BOOKS:
1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers

REFERENCE BOOKS:
1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
DATA ANALYTICS
(Open Elective – III)

B.Tech. IV Year II Sem.  
Course Code: EM831OE/CS853PE

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Prerequisites
1. A course on “Database Management Systems”
2. Knowledge of probability and statistics

Course Objectives: To explore the fundamental concepts of data analytics.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To understand the various search methods and visualization techniques.

Course Outcomes: After completion of this course students will be able to
- Understand the impact of data analytics for business decisions and strategy
- Carry out data analysis/statistical analysis
- To carry out standard data visualization and formal inference procedures
- Design Data Architecture
- Understand various Data Sources

UNIT - I
Data Management: Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data Quality (noise, outliers, missing values, duplicate data) and Data Processing & Processing.

UNIT - II
Data Analytics: Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

UNIT - III
Regression – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.
Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT - IV
Object Segmentation: Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc.
Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction
UNIT - V
Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

TEXT BOOKS:
1. Student’s Handbook for Associate Analytics – II, III.

REFERENCE BOOKS:
1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addison Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
NON-CONVENTIONAL POWER GENERATION
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.  L  T  P  C
Course Code: EE511OE  3  0  0  3

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

UNIT - II

UNIT - III

UNIT - IV

UNIT - V

TEXT BOOKS:

REFERENCE BOOKS:
B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ELECTRICAL ENGINEERING MATERIALS
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.                  L  T  P  C
Course Code: EE512OE                  3  0  0  3

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, Magnetostriiction, 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, bimetal 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:

Reference Books:
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

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.

UNIT- III

UNIT - IV
UNIT - V


TEXT BOOKS:


REFERENCES BOOKS:

3. Transport in Nano structures- David Ferry, Cambridge University press 2000
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

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

Prerequisite: Power systems - I & Power Systems - II

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
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:

Reference Books:
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

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 (H2), 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:

Reference Book:
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.


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 , resetable 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.


UNIT – IV

UNIT – V

**TEXT BOOKS:**
2. Introduction to Mechatronics / Appukuttan /Oxford

**REFERENCE BOOKS:**
B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ENTREPRENEUR RESOURCE PLANNING
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem. L T P C
Course Code: EE831OE 3 0 0 3

(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).
   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).
   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

UNIT - II

UNIT - III

UNIT - IV

UNIT - V

**TEXT BOOKS:**

**REFERENCE BOOKS:**
B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
MANAGEMENT INFORMATION SYSTEM (MIS)
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.  
Course Code: EE832OE  
L  T  P  C
3  0  0  3

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

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

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


TEXT BOOKS:
8. Vaman, ERP in Practice, TMH, 2009

REFERENCE BOOKS:
1. Dharminder and Sangeetha: Management Information Systems, Excel, 2009
4. Olson: Managerial Issues of ERO, TMH, 2009
B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ORGANIZATIONAL BEHAVIOUR
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.                  L  T  P  C
Course Code: EE833OE                  3  0  0  3

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

UNIT – II

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

UNIT – V

TEXT BOOKS:
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008

REFERENCE BOOKS:
3. Aswathappa: Organisational Behaviour, Himalaya, 2009
B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
ELECTRONIC MEASUREMENTS AND INSTRUMENTATION
(Open Elective – I)

B.Tech. III Year I Sem.            L   T   P   C
Course Code: EI511OE             3   0   0   3

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

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.


**TEXT BOOKS:**

**REFERENCE BOOKS:**
B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
INDUSTRIAL ELECTRONICS
(Open Elective – II)

B.Tech. III Year II Sem. 
Course Code: EI621OE  

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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 wielding, Electronic DC Motor Control.**

**Industrial Applications - II:** High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties,

TEXTBOOKS:

REFERENCE BOOKS:
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

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

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

UNIT – IV
UNIT – V


TEXT BOOKS:

REFERENCE BOOKS:
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
Course Objective: To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation, and programming.

UNIT – I

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

TEXT BOOKS

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.
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.            L  T/P/D  C
Course Code: ME511OE             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


UNIT – II

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:** Univariant method, Powell’s method and steepest descent method.

UNIT – IV

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:**

**REFERENCE BOOKS:**
B.TECH. MECHANICAL ENGINEERING
COMPUTER GRAPHICS
(Open Elective - I)

B.Tech. III Year I Sem.  L  T/P/D  C
Course Code: ME512OE  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:**

**REFERENCE BOOKS:**
B.TECH. MECHANICAL ENGINEERING
INTRODUCTION TO MECHATRONICS
(Open Elective - I)

B.Tech. III Year I Sem.
Course Code: ME513OE

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.

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, resetable 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.

UNIT – IV

UNIT – V

TEXT BOOKS:
2. Introduction to Mechatronics / Appukuttan /Oxford

REFERENCE BOOKS:
B.TECH. MECHANICAL ENGINEERING
FUNDAMENTALS OF MECHANICAL ENGINEERING
(Open Elective - I)

B.Tech. III Year I Sem.
Course Code: ME514OE

Pre-Requisites: None
Course Objectives: Understanding of basic principles of Mechanical Engineering is required in various fields 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

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.

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

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.  L  T/P/D  C
Course Code: ME621OE  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

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

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

UNIT - II

UNIT - III
UNIT - IV
Trajectory planning: Joint space scheme- Cubic polynomial fit-Obstacle avoidance in operation space-cubic polynomial fit with via point, bleeding 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:
2. Robotics / Ghosal / Oxford
B.TECH. MECHANICAL ENGINEERING
FABRICATION PROCESSES
(Open Elective –II)

B.Tech. III Year II Sem. L T/P/D C
Course Code: ME623OE 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

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

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

TEXT BOOKS:

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.
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. L T/P/D C
Course Code: ME832OE 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

UNIT II

UNIT - III
Manufacture, Storage and Import of Hazardous Chemical Rules 1989:

UNIT - IV
Other Acts and Rules:

UNIT - V
International Acts and Standards:

TEXT BOOKS:

REFERENCE BOOKS:
B.TECH. MECHANICAL ENGINEERING
BASICS OF THERMODYNAMICS
(Open Elective - III)

B.Tech. IV Year II Sem.
Course Code: ME833OE

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

UNIT – II

UNIT – III

UNIT - IV
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

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.  
Course Code: ME834OE/AM852PE/EI862PE  
Course Code: ME834OE/AM852PE/EI862PE  
Course Code: ME834OE/AM852PE/EI862PE

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 irrepairable 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 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.

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.

TEXT BOOKS:

REFERENCE BOOK:
Course Objectives: Understand the philosophies of various Manufacturing processes.

Course Outcomes: For given product, one should be able identify the manufacturing process.

UNIT – I

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

UNIT – IV

UNIT – V

TEXT BOOKS:

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.  L T P C
Course Code: NT512OE  3 0 0 3

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 steal 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
UNIT - III

UNIT - IV

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:

REFERENCES:
B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND
NANOTECHNOLOGY)
FUNDAMENTALS OF ENGINEERING MATERIALS
(Open Elective - I)

B.Tech. III Year I Sem. L    T    P   C
Course Code: NT513OE 3    0    0    3

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 steal and ferrous metals.
The objectives aim to:
  • Identify the basic crystalline structure of steal.
  • 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

UNIT – IV

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

**REFERENCE BOOKS:**
1. Introduction to Physical Metallurgy / Sidney H. Avner.
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.                  L  T  P  C
Course Code: NT621OE                    3  0  0  3

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:

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 NANO TECHNOLOGY) 
NON-CONVENTIONAL ENERGY SOURCES 
(Open Elective – II)

B.Tech. III Year II Sem. 
Course Code: NT622OE

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 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 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

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:

REFERENCE BOOKS:
1. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, 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  

L T P C  
3 0 0 3

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


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.

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.                                   L  T  P  C
Course Code: NT831OE                                   3  0  0  3

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

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:**

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.                        L  T  P  C
Course Code: NT832OE                      3  0  0  3

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

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:
3. Nanostructures and Nanomaterials by Guozhong Cao
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
7. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J. Muray

REFERENCE BOOKS:
2. Encyclopedia of Nanotechnology by H.S. Nalwa
B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND
NANOTECHNOLOGY)
CHARACTERIZATION OF NANOMATERIALS
(Open Elective - III)

B.Tech. IV Year II Sem.  L  T  P  C
Course Code: NT833OE  3  0  0  3

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
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:
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:
3. Paul E. West, introduction to Atomic Force Microscopy Theory Practice Applications
B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
ANALOG AND DIGITAL IC APPLICATIONS
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.  
Course Code: MT511OE  
L T P C  3 0 0 3

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.


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.

UNIT - V


Memories: ROM architecture, types, & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

TEXT BOOKS:


REFERENCES:

2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
INTELLECTUAL PROPERTY RIGHTS
(Open Elective – I)

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

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.,
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
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:

REFERENCES:
B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)  
DATA STRUCTURES  
(Open Elective – II)

B.Tech. III Year II Sem.  
Course Code: EM614PE/MT621OE  
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.  
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:

REFERENCE BOOKS:
7. Data Structures, S. Lipscutz, Schaum’s Outlines, TMH.
11. Advanced Data structures, Peter Brass, Cambridge.
B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
ARTIFICIAL NEURAL NETWORKS
(Open Elective – II)

B.Tech. III Year II Sem.                                      L    T    P    C
Course Code: MT622OE                                       3    0    0    3

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 Pattern 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:

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
UNIT - I

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

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

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

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.  
Course Code: MT831OE/ME853PE

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

UNIT-II

UNIT-III
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
B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
PRODUCTION PLANNING AND CONTROL
(Open Elective – III)

B.Tech. IV Year II Sem.
Course Code: MT832OE/ME854PE
L    T    P    C
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
Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV
UNIT – V
_DISPATCHING: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.


TEXT BOOKS:  

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

L    T    P    C
3     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:

Units – 5: Strategic perspectives in Entrepreneurship:

TEXT BOOKS:
REFERENCES:
1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
MATERIAL CHARACTERIZATION TECHNIQUES
(OPEN ELECTIVE –I)

B.Tech. III Year I Sem.

Course Code: MM511OE

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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


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.


UNIT-III

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, Dialatometry.

TEXT BOOKS:

REFERENCES:
B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
SCIENCE AND TECHNOLOGY OF NANO MATERIALS
(OPEN ELECTIVE - II)

B.Tech. III Year II Sem. Course Code: MM621OE

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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, microstructure 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**

**UNIT-V**
Nanostructured materials with high application potential: Quantum dots, Carbon nanotubes, GaN Nanowires, Nanocrystalline Zno, Nanocrystalline TiO₂, Multilayered films

**TEXT BOOKS:**
2. Nano Essentials: T Pradeep / TMH

**REFERENCES:**
1. Springer Handbook of Nanotechnology
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

TEXT BOOKS:
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
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
3 0 0 3

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

REFERENCES
B.TECH. MINING ENGINEERING
INTRODUCTION TO MINING TECHNOLOGY
(Open Elective - I)

B.Tech. III Year I Sem
Course Code: MN511OE

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:

REFERENCE BOOKS:
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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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 geominning 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

TEXT BOOKS:
1. Underground Coal Mining Methods – J.G. SINGH

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

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:

REFERENCE BOOKS:
B.TECH. MINING ENGINEERING
HEALTH AND SAFETY IN MINES
(Open Elective - III)

B.Tech. IV Year II Sem
Course Code: MN832OE

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

REFERENCE BOOKS:
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.                         L  T/P/D  C
Course Code: PE511OE                       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 places: 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**  
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.

TEXT BOOKS:

REFERENCE BOOKS:
B.TECH. PETROLEUM ENGINEERING
RENEWABLE ENERGY SOURCES
(Open Elective - I)

B.Tech. III Year I Sem.  
Course Code: PE512OE
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

UNIT-II

UNIT-III
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
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

UNIT – II

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

UNIT – V

**TEXT BOOKS:**

**REFERENCES:**
1. Water and Waste Water Technology by Steel, Wiley
B.TECH. PETROLEUM ENGINEERING
ENERGY MANAGEMENT AND CONSERVATION
(Open Elective - II)

B.Tech. III Year II Sem.
Course Code: PE621OE

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**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**

**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**

**UNIT-IV**

**UNIT-V**
Energy Management in Boilers and Fired systems – Steam and condensate systems –

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:
   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
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

UNIT – II
**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:** Univariant method, Powell’s method and steepest descent method.

**UNIT – IV**


**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:**


**REFERENCE BOOKS:**

B.TECH. PETROLEUM ENGINEERING
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES
(Open Elective – II)

B.Tech. III Year II Sem. Course Code: PE623OE

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:

Units – 5: Strategic perspectives in Entrepreneurship:

TEXT BOOKS:
REFERENCES:
1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
B.TECH. PETROLEUM ENGINEERING
DISASTER MANAGEMENT
(Open Elective – III)

B.Tech. IV Year II Sem.
Course Code: PE831OE

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.

REFERENCES:
B.TECH. PETROLEUM ENGINEERING
FUNDAMENTALS OF LIQUEFIED NATURAL GAS
(Open Elective – III)

B.Tech. IV Year II Sem.  L  T/P/D  C
Course Code: PE832OE  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
Cascade process: Description of ConocoPhillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.

UNIT-III

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 C₂⁺ 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
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.

TEXT BOOK:

REFERENCE BOOKS:
B.TECH. PETROLEUM ENGINEERING
HEALTH, SAFETY AND ENVIRONMENT IN PETROLEUM INDUSTRY
(Open Elective - III)

B.Tech. IV Year II Sem.  L  T/P/D  C
Course Code: PE833OE  3  0/0/0  3

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
Environmental transport of petroleum wastes: Surface paths- Subsurface paths- Atmospheric paths. Planning for Environmental protection.
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:

REFERENCE BOOKS: