

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

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE701PC	Flight Vehicle Design	4	1	0	4
2	AE702PC	Mechanical Vibration and Structural Dynamics	4	1	0	4
3		Professional Elective - II	3	0	0	3
4		Professional Elective - III	3	0	0	3
5		Professional Elective - IV	3	0	0	3
6	AE703PC	Flight Vehicle Design and Instrumentation Lab	0	0	3	2
7	AE704PC	Computational Fluid Dynamics Lab	0	0	3	2
8	AE705PC	Industry Oriented Mini Project	0	0	3	2
9	AE706PC	Seminar	0	0	2	1
		<b>Total Credits</b>	<b>17</b>	<b>2</b>	<b>11</b>	<b>24</b>

**IV YEAR II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	AE801PC	Major Project	0	0	30	15
		<b>Total Credits</b>	<b>9</b>	<b>0</b>	<b>30</b>	<b>24</b>

**Professional Elective - I**

ME611PE	Finite Element Methods
AE612PE	Experimental Aerodynamics
AE613PE	Mechanisms and Mechanical Design
AE614PE	Unmanned Air Vehicle (UAV) Systems

**Professional Elective - II**

AE721PE	CAD/CAM
AE722PE	Aircraft Maintenance Engineering
AE723PE	Material Science and Composites
ME724PE	Operations Research

**Professional Elective - III**

AE731PE	Aircraft Structural Design
ME732PE	Computational Fluid Dynamics
AE733PE	Airport Planning and Management
AE734PE	System Modeling and Simulation

**Professional Elective - IV**

AE741PE	Advanced Manufacturing Techniques
AE742PE	Air Traffic Control
AE743PE	Space Mechanics
AE744PE	Mechanics of Composite Structures

**Professional Elective - V**

AE851PE	Helicopter Engineering
AE852PE	Fabrication and Machining of Composite Structures
AE853PE	Airlines Planning, Scheduling and Operations
AE854PE	Hypersonic Aerodynamics

**Professional Elective -VI**

AE861PE	Aeroelasticity
AE862PE	Wind Engineering and Industrial Aerodynamics
AE863PE	Heat Transfer
AE864PE	Ground Vehicle Aerodynamics

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

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

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

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

<b>S. No.</b>	<b>Name of the Department Offering Open Electives</b>	<b>Open Elective – I (Semester – V)</b>	<b>Open Elective – II (Semester – VI)</b>
1	Aeronautical Engg.	AE511OE: Introduction to Space Technology	AE621OE: Introduction to Aerospace Engineering
2	Automobile Engg.	CE511OE: Disaster Management MT512OE: Intellectual Property Rights	MT621OE: Data Structures MT622OE: Artificial Neural Networks
3	Biomedical Engg.	BM511OE: Reliability Engineering	BM621OE: Medical Electronics
4	Civil Engg.	CE511OE: Disaster Management.	CE621OE: Remote Sensing and GIS CE622OE: Geo-Informatics CE623OE: Intellectual Property Rights
5	Civil and Environmental Engg.	CE511OE: Disaster Management	CN621OE: Environmental Impact Assessment CE623OE: Intellectual Property Rights
6	Computer Science and Engg. / Information Technology	CS511OE: Operating Systems CS512OE: Database Management Systems	CS621OE: Java Programming CS622OE: Software Testing Methodologies CS623OE: Cyber Security
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC511OE: Principles of Electronic Communications	EC621OE: Principles of Computer Communications and Networks
8	Electronics and Computer Engg.	EM511OE: Scripting Languages	EM621OE: Soft Computing Techniques
9	Electrical and Electronics Engg.	EE511OE: Non-Conventional Power Generation EE512OE: Electrical Engineering Materials EE513OE: Nanotechnology	EE621OE: Design Estimation and Costing of Electrical Systems EE622OE: Energy Storage Systems EE623OE: Introduction to Mechatronics
10	Electronics and Instrumentation Engg.	EI511OE: Electronic Measurements and Instrumentation	EI621OE: Industrial Electronics
11	Mechanical Engg.	ME511OE: Optimization Techniques ME512OE: Computer Graphics ME513OE: Introduction to Mechatronics ME514OE: Fundamentals of Mechanical Engineering	ME621OE: World Class Manufacturing ME622OE: Fundamentals of Robotics ME623OE: Fabrication Processes
12	Mechanical Engg. (Material Science and Nanotechnology)	NT511OE: Fabrication Processes NT512OE: Non destructive	NT621OE: Introduction to Material Handling NT622OE: Non-Conventional

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

S. No.	Name of the Department Offering Open Electives	Open Elective –III (Semester – VIII)
1	Aeronautical Engg.	AE831OE: Air Transportation Systems AE832OE: Rockets and Missiles
2	Automobile Engg.	AM831OE: Introduction to Mechatronics AM832OE: Microprocessors and Microcontrollers
3	Biomedical Engg.	BM831OE: Telemetry and Telecontrol BM832OE: Electromagnetic Interference and Compatibility
4	Civil Engg.	CE831OE: Environmental Impact Assessment CE832OE: Optimization Techniques in Engineering CE833OE: Entrepreneurship and Small Business Enterprises
5	Civil and Environmental Engg.	CN831OE: Remote Sensing and GIS CE833OE: Entrepreneurship and Small Business Enterprises
6	Computer Science and Engg. / Information Technology	CS831OE: Linux Programming CS832OE: R Programming CS833OE: PHP Programming
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC831OE: Electronic Measuring Instruments
8	Electronics and Computer Engg.	EM831OE: Data Analytics
9	Electrical and Electronics Engg.	EE831OE: Entrepreneur Resource Planning EE832OE: Management Information Systems EE833OE: Organizational Behaviour
10	Electronics and Instrumentation Engg.	EI831OE: Sensors and Transducers, EI832OE: PC Based Instrumentation

11	Mechanical Engg.	ME831OE: Total Quality Management ME832OE: Industrial Safety, Health, and Environmental Engineering ME833OE: Basics of Thermodynamics ME834OE: Reliability Engineering
12	Mechanical Engg. (Material Science and Nanotechnology)	NT831OE: Concepts of Nano Science And Technology NT832OE: Synthesis of Nanomaterials NT833OE: Characterization of Nanomaterials
13	Mechanical Engg. (mechatronics)	MT831OE: Renewable Energy Sources MT832OE: Production Planning and Control CE833OE: Entrepreneurship and Small Business Enterprises
14	Metallurgical and Materials Engg.	MM831OE: Design and Selection of Engineering Materials
15	Mining Engg.	MN831OE: Solid Fuel Technology MN832OE: Health & Safety in Mines
16	Petroleum Engg.	PE831OE: Disaster Management PE832OE: Fundamentals of Liquefied Natural Gas PE833OE: Health, Safety and Environment in Petroleum Industry

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**FLIGHT VEHICLE DESIGN**

**B.Tech. IV Year I Sem.**  
**Course Code: AE701PC**

**L T P C**  
**4 1 0 4**

**UNIT – I**

**Overview of the Design Process, Sizing From a Conceptual Sketch:** Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, aircraft requirements, configuration options. Integrated product development and aircraft design. The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation, historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions.

**UNIT – II**

**Airfoil and Geometry Selection, Thrust to Weight Ratio, Wing Loading:** Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio and other airfoil considerations. Wing geometry and wing vertical location, wing tip shapes. Tail geometry and arrangements. Thrust to weight ratio, statistical estimation, thrust matching. Wing loading performance constraints. Selection of thrust-to-weight ratio and wing loading.

**Initial Sizing and Configuration Layout, Crew Station, Passengers And Payload:** Sizing with fixed engine and with turbo engine. Geometry sizing of fuselage, wing, tail, control surfaces. Development of configuration lay out from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots. Lofting- definition, significance and methods, flat wrap lofting. Special consideration in configuration lay out. Isobar tailoring, Sears-Haack volume distribution, structural load paths. Radar, IR, visual detectability, aural signature. Considerations of vulnerability, crashworthiness, producibility, maintainability. Fuselage design, crew station, passenger compartment, cargo provisions, weapons carriage, gun installation.

**UNIT – III**

**Propulsion and Fuel System Integration, Landing Gear and Subsystems:** Propulsion selection, jet engine integration, engine dimensions, inlet geometry, inlet location, capture area calculation, boundary layer diverters, nozzle integration, engine cooling provisions, engine size estimation. Fuel system design and integration. Landing gear arrangements, guidelines for lay out. Shock absorbers–types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration lay out. The baseline design layout and report of initial specifications.

**Baseline Design Analysis - Aerodynamics & Propulsion, Structures & Weight and Balance:** Estimation of lift curve slope, maximum lift coefficient, complete drag build up. Installed performance of an engine, installed thrust methodology, net propulsive force, part power operation. Aircraft loads, categories: manoeuvre, gust, inertial, power plant, landing gear loads. Limit loads, the V, n diagram. Air load distribution on lifting surfaces. Review of

methods of structural analysis. Material selection. Weights and moments statistical group estimation method, centre of gravity excursion control.

#### **UNIT – IV**

##### **Baseline Design - Stability and Control, Performance and Constraint Analysis:**

Estimation of static pitch stability, velocity stability and trim. Estimation of stability and control derivatives. Static lateral, directional stability and trim. Estimation of aircraft dynamical characteristics, handling qualities. Cooper – Harper scale, relation to aircraft dynamic characteristics. Performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance. Steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb. Level turning flight, instantaneous turn rate, sustained turn rate. Energy maneuverability methods of optimal climb trajectories and turns. The aircraft operating envelope. Take off analysis, Balanced field length. Landing analysis. Fighter performance measures of merit. Effects of wind on aircraft performance. Initial technical report of baseline design analysis and evaluation. Refined baseline design and report of specifications.

##### **Cost Estimation, Parametric Analysis, Optimisation, Refined Sizing and Trade Studies:**

Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, fuel and oil costs, crew salaries, maintenance expenses, depreciation. Cost measures of merit. Aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis. Parametric analysis and optimisation. Refined conceptual sizing methods. Sizing matrix plot and carpet plot. Trade studies, design trades, requirement trades, growth sensitivities. Multivariable design optimization methods. Measures of merit. Determination of final baseline design configuration, preparation of type specification report.

#### **UNIT - V**

**Case Studies and Design of Unique Aircraft Concepts:** Design of the DC – 1, DC – 2, DC-3 aircraft, Boeing B-47 and 707, General Dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber. A survey of the Indian aircraft design effort. Design of VTOL aircraft, helicopters, hypersonic vehicles, delta and double delta wings, forward swept wings, uninhabited air vehicles.

#### **TEXT BOOKS:**

1. Raymer, Daniel P. (2006), Aircraft Design: A Conceptual Approach, 4th edition, AIAA Educational Series, USA.
2. J. F. Marchman, L. R. Jenkinson (2003), Aircraft Design Projects for Engineering students, AIAA Publishers, USA.
3. Ajoy Kumar Kunda (2010), Aircraft Design, Cambridge University Press, UK.

#### **REFERENCE BOOKS**

1. Torenbeek E. (1986), Synthesis of Subsonic Airplane Design, Delft University Press, New York.

2. Bruhn. E. H (1973), Analysis and Design of Flight Vehicles Structures, New Edition, Jacobs Publishing House, USA.
3. Scheler E. E, Dunn L.G (1963), Airplane Structural Analysis and Design, John Wiley & Sons, USA.
4. D. Howe (2005), Aircraft conceptual Design Synthesis, John Wiley & Sons Publishers, USA.



**MECHANICAL VIBRATIONS AND STRUCTURAL DYNAMICS****B.Tech. IV Year I Sem.****L T P C****Course Code: AE702PC****4 1 0 4****UNIT – I**

**Free Vibration of Single-Degree-of-Freedom-System:** Importance of the Study of Vibration; Basic Concepts of Vibration - Elementary Parts of Vibrating Systems, Number of Degrees of Freedom, Discrete and Continuous Systems; Classification of Vibration - Free and Forced Vibration, Undamped and Damped Vibration, Linear and Nonlinear Vibration, Deterministic and Random Vibration; Vibration Analysis Procedure, Spring Elements, Mass or Inertia Elements, Damping Elements, Harmonic Motion, Harmonic Analysis. Introduction, Free Vibration of an Undamped Translational System, Free Vibration of an Undamped Torsional System, Response of First Order Systems and Time Constant, Rayleigh's Energy Method, Free Vibration with Viscous Damping, Graphical Representation of Characteristic Roots and Corresponding Solutions, Parameter Variations and Root Locus Representations, Free Vibration with Coulomb Damping, Free Vibration with Hysteretic Damping, Stability of Systems

**UNIT - II**

**Vibration Under Harmonic Forcing Conditions:** Introduction, Equation of Motion, Response of an Undamped System Under Harmonic Force, Response of a Damped System Under Harmonic Force, Response of a Damped System Under  $F(t)=F_0 e^{it}$ , Response of a Damped System Under the Harmonic Motion of the Base, Response of a Damped System Under Rotating Unbalance, Forced Vibration with Coulomb Damping, Forced Vibration with Hysteresis Damping, Forced Motion with Other Types of Damping, Self-Excitation and Stability Analysis, Transfer-Function Approach.

**UNIT - III**

**Vibration Under General Forcing Conditions:** Introduction, Response Under a General Periodic Force, Response Under a Periodic Force of Irregular Form, Response Under a Non-periodic Force, Convolution Integral, Response Spectrum, Laplace Transform, Numerical Methods, Response to Irregular Forcing Conditions Using Numerical Methods

**UNIT - IV**

**Two-Degree - and Multi-Degree-of-Freedom Systems:** Introduction, Equations of Motion for Forced Vibration, Free Vibration Analysis of an Undamped System, Torsional System, Coordinate Coupling and Principal Coordinates, Forced-Vibration Analysis, Semi-definite Systems, Self-Excitation and Stability Analysis Modeling of Continuous Systems as Multi-degree-of-Freedom Systems, Using Newton's Second Law to Derive Equations of Motion, Influence Coefficients - Stiffness Influence Coefficients, Flexibility influence Coefficients, Inertia Influence Coefficients; Potential and Kinetic Energy Expressions in Matrix Form, Generalized Coordinates and Generalized Forces, Using Lagrange's Equations to Derive Equations of Motion, Equations of Motion of Undamped Systems in Matrix Form, Eigen

value Problem, Solution of the Eigen value Problem, Expansion Theorem, Unrestrained Systems, Free Vibration of Undamped Systems, Forced Vibration of Undamped Systems Using Modal Analysis, Forced Vibration of Viscously Damped Systems, Self-Excitation and Stability Analysis

#### **UNIT – V**

**Continuous Systems:** Introduction, Transverse Vibration of a String or Cable, Longitudinal Vibration of a Bar or Rod, Torsional Vibration of a Shaft or Rod, Lateral Vibration of Beams, The Rayleigh-Ritz Method.

#### **TEXT BOOKS:**

1. Rao, S.S., Mechanical Vibrations, Fifth Edition, Prentice-Hall, 2011.
2. Thomson, W.T., Theory of vibrations with applications, CBS Publishers, Delhi.
3. Meirovitch, L., Fundamentals of vibrations, McGraw Hill International Edition, 2001.

#### **REFERENCES:**

1. Leissa, A.W., Vibration of continuous system, The McGraw-Hill Company, 2011.
2. Inman, D.J., Vibration Engineering, Third Edition, Prentice Hall Int., Inc., 2001,
3. Kelly, S.G., Schaum's Outline of The Theory and Problems of Mechanical Vibrations, Schaum's Outline Series, McGraw-Hill, 1996.

**CAD/CAM**  
**(PROFESSIONAL ELECTIVE – II)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE721PE**

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

**Pre-requisites:** To learn the importance and use of computer in design and manufacture

**Course objectives:** To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

**Course Outcomes:** Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT – I**

Fundamentals of CAD, CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

**Geometric Modeling:** 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

**UNIT - II**

**Surface modeling:** Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

**Solid Modelling:** Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

**UNIT – III**

**NC Control Production Systems:** Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

#### **UNIT – IV**

**Group Technology:** Part families, Parts classification and coding. Production flow analysis, Machine cell design.

**Computer aided process planning:** Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

**Computer aided manufacturing resource planning:** Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

#### **UNIT – V**

**Flexible manufacturing system:** F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

**Computer aided quality control:** Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM

#### **TEXT BOOKS:**

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P.N.Rao / Mc Graw Hill

#### **REFERENCE BOOKS:**

1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

**AIRCRAFT MAINTENANCE ENGINEERING**  
**(PROFESSIONAL ELECTIVE – II)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE722PE**

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

**UNIT- I**

**Philosophy of Aircraft Maintenance:** Definition of maintenance, Objectives of a maintenance program, Outline of aviation maintenance program, summary of FAA requirements, additional maintenance program requirements; Organization of maintenance and engineering, organization structure, M&E organization chart, general groupings, Managerial Level Functions-technical services, aircraft maintenance, overhaul shops, material, maintenance program evaluation directorates, summary of management levels, organization structure and TPPM, variations from the typical organization role of the engineer, role of the mechanic, two types of maintenance, reliability, redesign, failure rate patterns, other maintenance considerations, establishing a maintenance program. Goals and objectives of maintenance, Discussion of the five objectives

**UNIT- II**

**Development of Maintenance Programs, Certification and Maintenance Documentation:** Maintenance Steering Group(MSG) Approach, Process-Oriented maintenance, Task-oriented maintenance, Current MSG process-MSG-3, Maintenance program documents, maintenance intervals defined, changing basic maintenance intervals, maintenance program content; Aircraft certification, delivery inspection, operator certification, certification of personnel, aviation industry interaction; Types of documentation, manufacturer's documentation, regulatory documentation, airline generated documentation, ATA document standards, closer look of TPPM

**UNIT- III**

**Technical Services:** Engineering: makeup of engineering, mechanics and engineers, engineering department functions, engineering order preparation; Production Planning & Control-forecasting, production planning, production control, feedback for planning, organization of PP&C; Technical Publications-functions of technical publications, airline libraries, control of publications, document distribution; Technical Training-organization, training for aviation maintenance, airframe manufacturer's training courses, other airline training courses; Computer support-airlines uses of computers

**UNIT- IV**

**Maintenance and Material Support:** Line Maintenance(on-aircraft)-makeup of line maintenance, functions that control maintenance, maintenance control centre responsibilities, general line maintenance operations, aircraft logbook, ramp and terminal operations, other line maintenance activities, line station activities, maintenance crew requirements, morning meeting; Hangar Maintenance(on-aircraft)-organization of hangar maintenance, problem areas in hangar maintenance, maintenance support shops, ground support equipment, typical

C-check; Maintenance overhaul shops(off-aircraft)-organization, types and operation of overhaul shops,

Shop data collection; Material support-organization and function of material, material directorate, M&E support functions

#### **UNIT- V**

**Oversight Functions:** Quality Assurance-requirements for QA, quality audits, ISO 9000 quality standard, technical records, other functions of QA; Quality Control-quality control organization, FAA and JAA differences, QC inspector qualifications, basic inspection policies, other QC activities; Reliability-definition and types of reliability, elements of a reliability program; Maintenance Safety-industry safety, safety regulations, maintenance safety program, general responsibilities for safety, general safety rules, accident and injury reporting; Troubleshooting- three levels of troubleshooting, knowledge of malfunctions, knowledge is power, building your own knowledge base, understanding the sequence of events, eight basic concepts of troubleshooting

#### **TEXT BOOKS:**

1. Kinnison, H.A., Aviation Maintenance Management, Second Edition, McGraw-Hill, 2013.
2. McKinley, J. L., Bent, R.D., Maintenance and Repair of Aerospace Vehicles, Northrop Institute of Technology, McGraw Hill, 1967

#### **REFERENCES:**

1. Friend, C.H., Aircraft Maintenance Management, Longman, 1992.
2. Kroes, M., Watkins, W., and Delp, F. Aircraft Maintenance and Repair, Tata McGraw-Hill, 2010.
3. Patankar, M.S. And Taylor, J.C., Risk Management and Error Reduction in Aviation Maintenance, Ashgate, 2004, ISBN 0-7546-1941-9.

**MATERIAL SCIENCE AND COMPOSITES**  
**(PROFESSIONAL ELECTIVE – II)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE723PE**

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

**UNIT - I**

**Introduction:** Definition, Classification of Composite materials based on structure based on matrix. Advantages of composites, application of composites, functional requirements of reinforcement and matrix.

**UNIT - II**

**Fibers:** Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers, properties and applications of whiskers, particle reinforcements.

**UNIT - III**

**Manufacturing of Advanced Composites:** Polymer matrix composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method. Filament winding method, Compression moulding, Reaction injection moulding.

**UNIT - IV**

**Manufacturing of Metal Matrix Composites:** Casting, Solid State diffusion technique, Cladding - Hot isostatic pressing. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering.  
Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving.

**UNIT - V**

**Response of Composites to Stress:** (a) Iso Strain condition (b) Iso Stress condition (c) Load friction shared by the fibers.

**TEXT BOOKS:**

1. V. C. H. Cahn (2007), Material Science and Technology, Vol. 13, 3rd edition, Wiley WCH, West Germany.
2. K. K. Chawla (2010), Composite Materials, 2nd edition, Springer, USA.

**REFERENCE BOOKS:**

1. E. D. Lubin (2003), Hand Book of Composite Materials, 3rd edition, Tata McGraw-Hill, New Delhi, India.
2. Muhammad M. Rafique (2009), Composite Materials: Processing and Technology, 2nd edition, Academy Press, Lap Lambert.
3. P. K. Sinha (2006), Composite Materials and structure, IIT Kharagpur, India

**OPERATIONS RESEARCH  
(PROFESSIONAL ELECTIVE – II)**

**B.Tech. IV Year I Sem.****L T P C****Course Code: ME724PE/MT734PE/AM743PE****3 0 0 3**

**Course Objectives:** Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

**Course Outcome:** Understanding the problem, identifying variables & constants, formulas of optimization model and applying appropriate optimization Tech

**UNIT – I**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**Allocation:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II**

**Transportation Problem** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT – III**

**Sequencing** – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines-graphical model. **Replacement:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

**UNIT – IV**

**Theory of Games:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**Inventory:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT – V**

**Waiting Lines:** Introduction–Terminology-Single Channel–Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.



**Dynamic Programming:** Introduction – Terminology- Bellman’s Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

**TEXT BOOKS:**

1. Operations Research / N.V.S. Raju / SMS
2. Operations Research / ACS Kumar / Yes Dee

**REFERENCE BOOKS:**

1. Operations Research /J. K. Sharma / MacMilan.
2. Operations Research /A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi / Pearson.

**AIRCRAFT STRUCTURAL DESIGN  
(PROFESSIONAL ELECTIVE – III)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE731PE**

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

**UNIT-I**

**Introduction and Airworthiness Requirements:** Structural design and sizing stages, Principal Structural components of aircraft Design requirements- structural integrity, stiffness, service life, Constraints- baseline aerodynamic configuration, external loading, weight, operating conditions, conformity to government regulations. Design for durability, damage tolerance. Airworthiness requirements - loads, safety margins, material properties, methods of estimation construction, operation, maintenance, training-procedures. Critical load conditions. Limit and ultimate loads- definition, significance. Aircraft materials-mechanical properties- design data-allowable, allowable bases. Failure theory. Flight loads-atmospheric, manoeuvre - construction of flight envelope.

**UNIT-II**

**External Loads – Estimation, Fasteners and Structural Joints:** Wing loads- air load span wise distribution, effect of fuselage, engine nacelle, wing stores, control surfaces, landing, taxi, dynamic gust loads, wing weight distribution. Empennage loads- gust, manoeuvre, control surface. Fuselage loads- distribution of weight, fore body loads, after body loads, internal pressure, propulsion loads. Landing gear loads- landing conditions, ground handling loads, retraction loads. Miscellaneous loads. Airplane weight data, stiffness data. Theories of Failure. Fasteners and fittings- role, significance, general design considerations, criteria for allowable strength. Margins of safety. Fastener systems, types, fastener information, dimensions, material, allowable strength- tensile, shear, bending, bearing, Rivets, bolts and screws, nuts- detail design considerations. Fastener selection. Fittings- lugs, bushings and bearings- loading, design and analysis. Joints- spliced, eccentric, gusset, welded, brazed, bonded-types, methods of joining, failure modes. Fatigue design considerations. Stress concentration- causes, methods of reduction. Fastener load distribution and bypass load-severity factor, structural joint life prediction. Shim control and requirement.

**UNIT- III**

**Design of Wing, Tail Unit Structures:** The wing- role- summary of wing loads, structural Components- wing box, leading and trailing edges. Wing layout- location of spars, ailerons and flaps, rib spacing and direction, root rib bulkhead, span wise stiffeners, wing covers-skin-stringer panels, integrally stiffened panels, access holes, and attachment of leading edge and trailing edge panels. Spars- general rules of spar design. Ribs and bulkheads- rib spacing and arrangement. Wing root joints, carry through structure. Fighter wing design- problems with swept wings Wing box, root rib bulkhead- estimation of loads, stress analysis, design parameters, optimization, sizing, margins of safety. Leading and trailing edge assembly-control surfaces, flaps- structure.

**UNIT-IV**

**Design of Fuselage, Landing Gear, Engine Mounts:** Function of fuselage-loading, general requirements. Ultimate strength of stiffened cylindrical structure- review, Principal structural components- skin and stringers, frame and floor beam, pressure bulkhead, wing and fuselage intersection- lay out, loading, stress analysis, sizing. Forward fuselage, aft fuselage structures, fuselage openings- windows, doors- design considerations. Landing gear- purpose, types, general arrangement, loads- design considerations- ground handling, take-off, landing, braking, pavement loading, support structure. Stowage and retraction, gear lock kinematic design. Shock absorbers- function, types, components, operation, loads, materials, design. Wheels and brakes, tire selection Engine mounts- types-wing pod, rear fuselage, tail, fuselage mount, loads, design considerations.

**UNIT- V**

**Fatigue Life, Damage Tolerance, Fail-Safe Design- Weight Control and Balance:** Catastrophic effects of fatigue failure- examples- modes of failure-design criteria- fatigue stress, fatigue performance, fatigue life. Fatigue design philosophy- fail-safe, safe life. Service behaviour of aircraft structures- effect of physical and load environment design and of detail of fabrication Structural life methods of estimation- the scatter factor- significance Fail-safe design-the concept, requirements, damage tolerance- estimation of fatigue strength

**TEXT BOOKS:**

1. Niu, M.C., Airframe Structural Design, second edition, Hong kong Conmlit Press, 1988, ISBN: 962-7128- 09-0.
2. Niu, M.C., Airframe Stress Analysis, and Sizing, second edition, Hong kong Conmlit Press, 1997, ISBN: 962-7128-08-2.

**REFERENCES**

1. Bruhn, E.H., Analysis and Design of Flight Vehicles Structures, Tri - state Offset Company, USA, 1965.
2. Peery, D.J, and Azar, J.J., Aircraft Structures, second edition, Mc Graw-Hill, N.Y., 1993.
3. Megson, T.H.G., Aircraft Structures for Engineering Students, Butterworth-Heinemann/ Elsevier, 2007.
4. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347- 281-0.
5. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.

**COMPUTATIONAL FLUID DYNAMICS  
(PROFESSIONAL ELECTIVE – III)**

**B.Tech. IV Year I Sem.****L T P C****Course Code: ME732PE/AM741PE****3 0 0 3****UNIT - I:**

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm

Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

**UNIT - II:**

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

**UNIT - III:**

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition –Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

**UNIT - IV:**

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack’s Technique

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid

Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations

**UNIT - V:**

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity  
Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

**REFERENCE BOOKS:**

1. Computational Fluid Flow and Heat Transfer – K Muralidharan and T Sudarajan, Narosa Publishers
2. Computational Fluid Dynamics : The basics with applications – John D Anderson, McGraw Hill Publications

**AIRPORT PLANNING AND MANAGEMENT  
(PROFESSIONAL ELECTIVE – III)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE733PE**

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

**UNIT- I**

**Airport and Airport Systems:** Introduction, Airport management on an International level, The National Plan of Integrated Airport Systems, The rules that govern airport management, organizations that influence airport regulatory bodies; Airport organization and administration: Airport ownership and operation, the airport organization chart, the airport manager and public relations

**UNIT-II**

**The Airfield, Airspace and Air Traffic Management:** Airfield: The components of an airport, the airfield, airfield lighting, navigational aids located on airfields, air traffic control and surveillance facilities located on the airfield, weather reporting facilities located on airfields, security infrastructure on airfields; Airspace and Air Traffic Management: The present-day air traffic control management and operating infrastructure, The basics of air traffic control, Current and future enhancements to air traffic management

**UNIT - III**

**Airport Operations Management, Airport Terminals and Ground Access, Airport Security:** Airport Operations: Inspection and compliance, Specific Areas of Importance-Pavement management, runway surface friction, aircraft rescue and fire fighting, snow and ice control, self inspection programs, safety management systems for airports; Airport Terminals and Ground Access: Historical Development of airport terminals, components of the airport terminal, airport ground access; Airport Security-The transportation security administration, security at commercial service airports, security at general aviation airports, the future of airport security

**UNIT - IV**

**Airport Financial Management, Airport Planning:** Airport Financial Management: Introduction, airport financial accounting, liability insurance, planning and administering an operational budget, revenue strategies at commercial airports, pricing of airport facilities and services, variation in the sources of operating revenues, rise in airport financial burdens, airport funding, grant programs, airport financing, private investment; Airport Planning: Airport system planning, airport master plan, airport layout plan, forecasting, facilities requirement, design alternatives, financial plans, land use planning, environmental planning

**UNIT-V**

**Airport Capacity and Delay:** Introduction, Defining capacity, Factors affecting capacity and delay, estimating capacity, illustrating capacity with time-space diagram, FAA approximation charts, simulation models, defining delay, estimating delay, analytical estimates of delay-the

queuing diagram, other measures of delay, approaches to reducing delay, administrative and demand management

**TEXT BOOK:**

1. Seth B. Young and Alexander T. Wells, 'Airport Planning and Management', Sixth Edition, McGraw-Hill Education, 2011

**REFERENCES:**

1. Kazda, A. and Caves, R.E., 'Airport Design and Operation', 2<sup>nd</sup> edn., Elsevier, 2007.
2. Horonjeff, R., McKelvey, F.X., Sproule, W.J. and Young, S.B., 'Planning and Design of Airports', 5<sup>th</sup> edn., McGraw-Hill, 2010.
3. Norman J. Ashford, Pierre Coutu and John R. Beasley, 'Airport Operations', 3<sup>rd</sup> edition, McGraw-Hill, 2012.

**SYSTEM MODELING AND SIMULATION  
(PROFESSIONAL ELECTIVE – III)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE734PE**

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

**UNIT - I**

**Introduction to Simulation:** When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study. The basics of Spreadsheet simulation, Simulation example: Simulation of queuing systems in a spreadsheet; Concepts in Discrete-Event Simulation: The Event- Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling

**UNIT - II**

**Statistical Models in Simulation:** Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

**Queuing Models:** Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behaviour of M/G/1 queue; Networks of queues; Rough-cut modeling: An illustration

**UNIT - III**

**Random-Number Generation, Random-Variate Generation:** Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers Random-Variate Generation: Inverse transform technique; Acceptance- Rejection technique; Special properties

**UNIT - IV**

**Input Modeling:** Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate and Time-Series input models

**Estimation of Absolute Performance:** Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations

**UNIT - V**

**Verification, Calibration, and Validation; Optimization:** Model building, verification and validation; Verification of simulation models; Calibration and validation of models, optimization via Simulation



**TEXT BOOKS:**

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010

**REFERENCES**

1. Devendra K. Chaturvedi: Modeling and Simulation of Systems Using MATLAB and Simulink, CRC Press, Taylor and Francis Group, 2010
2. Frank L. Severance: System Modeling and Simulation: An Introduction, John Wiley & Sons Ltd, 2001

**ADVANCED MANUFACTURING TECHNIQUES  
(PROFESSIONAL ELECTIVE – IV)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE741PE**

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

**UNIT - I**

**Advanced Machining Processes:** Classification of Advanced Machining Process, Mechanical Energy Based Processes: AJM, WJM, AWJM and USM-Working Principles, Equipment, Process parameters, Applications, Electrical Energy Based Processes: EDM & WEDM-Working Principles, Equipment, Process parameters, Applications. Chemical and Electro-Chemical Energy Based Processes: CHM and ECM-Working Principles, Equipment, Process parameters, Applications. Thermal Energy Based Processes: LBM, PAM, EBM-Working Principles, Equipment, Process parameters, Applications.

**UNIT - II**

**Advanced Casting Processes:** Metal mould casting, Continuous casting, Squeeze casting, vacuum mould casting, Evaporative pattern casting, ceramic shell casting.

**UNIT - III**

**Advanced Welding Processes:** Electron Beam Welding (EBW), Laser Beam Welding (LBW), and Ultrasonic Welding (USW).

**UNIT - IV**

**Advanced Metal Forming Processes:** Details of High Energy Rate Forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming

**UNIT - V**

**Additive Manufacturing:** Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), 3-D Printing, Laminated Object Modeling (LOM), etc.

**TEXT BOOKS:**

1. Nontraditional Manufacturing Processes, G.F. Benedict, Marcel Dekker, Inc. New York.
2. Advanced Machining Processes, Vijay K. Jain, Allied Publishers Pvt. Ltd., New Delhi.
3. Manufacturing Engineering & Technology, Kalpakjian. S, Pearson Education Asia.
4. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi
5. Material and Processes in manufacturing, Paul De Garmo, J.T. Black, and Ronald A. Kohser, Prentice Hall of India Pvt. Ltd., New Delhi.

**AIR TRAFFIC CONTROL  
(PROFESSIONAL ELECTIVE – IV)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE742PE**

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

**UNIT - I**

**Air Traffic Control System Structure:** Airspace Classification-general categories of airspace, controlled versus uncontrolled airspace, IFR flight in controlled and uncontrolled airspace, VFR flight in controlled and uncontrolled airspace; Airspace Classes-classes A to G, special VFR, federal airways, flight levels, tango routes, special use airspace; Airport Air Traffic Control Communications-Radio communication, ATC communication procedures

**UNIT - II**

**Air Traffic Control Procedures and Organization:** Separation responsibilities in controlled airspace-air traffic control procedures-delegation of responsibility-controller duties in an air route traffic control centre-air traffic control tower responsibilities; Control Tower Procedures: control towers, flight data controller duties, clearance delivery controller duties-ground controller duties, local controller duties

**UNIT - III**

**Nonradar Enroute and Terminal Separation; Radar Separation:** Design of Separation Procedures, Airspace Dimensions, Separation Procedures: Vertical Separation, lateral separation, holding patterns, longitudinal separation, initial separation of aircraft, visual separation; Radar Separation: Aircraft identification, transfer of radar identification, basic radar separation, radar assisted navigation, radar arrivals and approaches, radar traffic information, use of automation tools

**UNIT - IV**

**Operation in the National Airspace System:** Overview of an IFR flight: Flight planning and IFR clearances, coded departure route, Traffic flow management programs, alternative routes, clearance delivery, phoenix airspace, ground control coded departure routes, local control, departure control, en-route separation, miles in trail restrictions, metering, delay techniques, approach control; example of a VFR flight; Oceanic and international air traffic control: International air traffic control, international airspace, European air traffic control

**UNIT - V**

**Future of the National Air Space System:** Automated air traffic control: Procedural separation standards, ATC Modernization; Current ATC Initiatives: Departure delay program, en-route metering program, en-route sector loading program; Procedural changes: National route program; CNS Improvements: Communication system changes, required navigation performance, navigation security and surveillance systems; Air traffic Management: Hardware, Next Generation air traffic control (NextGen), major components of NextGen, trajectory based operations, flexible airspace management,

collaborative air traffic management, negotiated routes, improved aircraft separation, additional ADS functions, en-route automation modernization

**TEXT BOOK:**

1. Fundamentals of Air Traffic Control, Michael S Nolan, Fifth Edition, 2011

**SPACE MECHANICS**  
**(PROFESSIONAL ELECTIVE – IV)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE743PE**

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

**UNIT - I**

**Basic Concepts:** The solar system, comets and meteors, Kepler's laws and Newton's law of gravitation, concept of celestial sphere, vernal equinox, ecliptic. Coordinate systems- ECI system, geographic coordinate system, azimuth-elevation coordinate system, ecliptic system, Time systems- sidereal time, mean solar time, Julian date, universal time, ephemeris time.

**UNIT - II**

**Two-Body and Restricted Three Body Problems:** N-body problem, two-body problem- simplifying assumptions, Equations of relative motion, Constants of the motion- conservation of angular momentum, Trajectory equation, elliptical orbit- geometry of the ellipse, period of an elliptical orbit, circular orbit, parabolic orbit, hyperbolic orbit. Geometry of the hyperbola, hyperbolic excess speed, Orbital elements.  
Introduction, equations of motion, Lagrangian points, stability of the Lagrangian points, Jacobi's integral, accessible regions.

**UNIT- III**

**Basic Orbital Manoeuvres and Orbit Perturbations:** Low altitude earth orbits- effect of orbital altitude on satellite life times, direct ascent to orbit, perturbations of low earth orbits due to the oblate shape of the Earth. High altitude earth orbits- the synchronous satellite, launching a high altitude satellite. In-plane orbit changes- adjustment of perigee and apogee height, Hohmann transfer, general coplanar transfer between circular orbits, Out-of plane orbit changes-simple plane change. General overview of orbit perturbations, Earth gravity harmonics, lunisolar gravitational attractions, solar radiation pressure effects, atmospheric drag effects, tidal friction effects and mutual gravitational attraction, earth's oblateness ( $J_2$ ) effects, critical inclination. Sun-synchronous orbits,  $J_3$  effects and frozen orbits, Earth's triaxiality effects and east-west station keeping.

**UNIT- IV**

**Ballistic Missile Trajectories:** The general ballistic missile problem- geometry of the trajectory, free flight range equations, flight path angle equation, maximum range trajectory, time of free flight. Effect of launching errors on range- effect of lateral displacement of the burnout point, cross range error due to incorrect launch azimuth, effect of down range displacement of the burnout point, errors in burn-out flight-path angle, down range errors caused by incorrect burnout height and in correct speed at burnout. The effect of earth rotation- compensating for the initial velocity of missile due to earth rotation, compensating for movement of the target due to earth rotation.

**UNIT- V**

**Interplanetary Trajectories:** Patched-conic approximation-heliocentric transfer orbit, phase angle at departure, escape from the earth's sphere of influence, arrival at the target planet, effective collision cross-section. Locating the planets- launch opportunity, synodic period, trajectory type and class, ephemeris calculations, Non-coplanar interplanetary trajectories, Gravity-assist manoeuvre. Fast interplanetary trajectories.

**TEXT BOOKS:**

1. Bate, R.R., Mueller, D.D. and White, J.E., *Fundamentals of Astrodynamics*, Dover Publications Inc., New York, 1971.

**REFERENCES:**

1. Wiesel, W.E., *Spaceflight Dynamics*, 3<sup>rd</sup> edn., McGraw-Hill, New York, 2010.
2. Hale, F.J., *Introduction to Space Flight*, Prentice Hall, 1994.
3. Sellers, J.J., *Understanding Space: An Introduction to Astronautics*, 2<sup>nd</sup> edn., McGraw-Hill, 2004
4. Chobotov, V.A., ed, *Orbital Mechanics*, 3rd edn., AIAA Education Series, 2002.
5. David A. Vallado, *Fundamentals of Astrodynamics and Applications*, 4<sup>th</sup> edition, Microcosm Press, 2013
6. Charles D. Brown, "Spacecraft Mission Design", AIAA Education Series, 1998
7. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics*, Pitman, 1979.

**MECHANICS OF COMPOSITE STRUCTURES  
(PROFESSIONAL ELECTIVE – IV)**

**B.Tech. IV Year I Sem.**  
**Course Code: AE744PE**

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

**UNIT- I**

**Introduction to Composite Materials:** Classification and characteristics, Mechanical behavior of composite materials, Basic terminology, Manufacture of laminated fiber-reinforced composite materials, Current and potential advantages of fiber-reinforced composite materials, Applications of composite materials.

**UNIT - II**

**Macromechanical Behavior of a Lamina:** Introduction, Stress-strain relations for anisotropic materials, Stiffnesses, compliances, and engineering constants for orthotropic materials, Restrictions on engineering constants, Stress-strain relations for plane stress in an orthotropic material, Stress-strain relations for a lamina of arbitrary orientation, Invariant properties of an Orthotropic lamina, Strengths of an Orthographic lamina, Biaxial strength criteria for an Orthotropic lamina.

**UNIT - III**

**Micromechanical and Macromechanical behavior of lamina:** Introduction, Mechanics of materials approach to stiffness, Elasticity approach to stiffness, Comparison of approaches to stiffness, Mechanics of materials approach to strength. Introduction, Classical lamination theory, Special cases of laminate stiffness, theoretical versus measured laminate stiffness, Strength of laminates, Inter-laminar stresses.

**UNIT - IV**

**Bending and Buckling of Laminated Plates:** Introduction, Governing equations, Deflection of simply supported laminated plates, under distributed transverse load, buckling of simply supported laminated plates under in-plane load.

**UNIT - V**

**Introduction to Design of Composite Structures:** Introduction to structural design, Materials selection, Configuration selection, Laminate joints, Design requirements and design failure criteria, Optimization concepts, Design analysis philosophy for composite structures.

**TEXT BOOK:**

1. Mechanics of Composite Materials, Robert. M. Jones, Second Edition, Taylor and Francis, 1999.

**REFERENCE BOOKS:**

1. Mechanics of Fibrous composites- Carl. T. Herakovich-John Wiley & Sons, 1997.
2. Advanced Composite Materials, Lalit Gupta, Himalayan Books. New Delhi, 1998.

**FLIGHT VEHICLE DESIGN AND INSTRUMENTATION LAB****B.Tech. IV Year I Sem.****L T P C****Course Code: AE703PC****0 0 3 2****List of Experiments**

1. Specification of design requirements- mission profile-conceptual sketches, initial sizing.
2. Airfoil and geometry selection, determination of thrust to weight ratio, wing loading.
3. First sizing & configuration layout, crew station, passengers & payload.
4. Baseline design- stability & control, performance and constraint analysis.
5. Cost estimation, parametric analysis, optimization, refined sizing & trade studies.
6. Determination of final baseline design configuration, preparation of specification report.
7. Hydraulic system.
8. Pneumatic system.
9. Demonstration on (a) Landing gears (b) Shock absorbers (c) Electro-mechanical operations of Elevators, Rudder, Flap etc on an actual aircraft (d) Artificial Horizon, Airspeed Indicator,
10. Instrument landing system.

**REFERENCES:**

1. Jenkinson, L.R. and Marchman III, J. F., Aircraft Design Projects for Engineering Students,
2. Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.
3. Raymer, D.P., Aircraft Design: A Conceptual Approach, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
4. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0- 521-657222-9.AIAA Aerospace Design Engineer's Guide, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
5. Keane, A.J. And Nair, P.B., Computational Approaches for Aerospace Design, Wiley, 2005, ISBN:0-470-85540-1.
6. Taylor, J., Jane's All the World Aircraft, latest edition, Jane's, London.
7. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.



**COMPUTATIONAL FLUID DYNAMICS LAB****B.Tech. IV Year I Sem.****L T P C****Course Code: AE704PC****0 0 3 2**

1. Numerical solutions for any one of the following using Finite Difference method

Elliptic Equations

Parabolic Equations

Hyperbolic Equations

2. Grid generations for any one of the following

Algebraically stretched Cartesian grids

Elliptic Grids

3. Numerical Solutions for any one of the following

Vortex Panel method

Source Panel method

Incompressible Couette flow

Supersonic flow over a flat plate

Grid generation of aerofoil NACA 0012

**Equipment Needed For CFD Lab**

1. Computers P- IV with 1GB Ram and parallel computational facilities 30 nos / 30 students a batch.
2. Licensed Software's
  - a. MAT LAB
  - b. ANSYS
  - c. CFX

**HELICOPTER ENGINEERING**  
**(PROFESSIONAL ELECTIVE – V)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE851PE**

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

**UNIT- I**

**Basic Concepts:** Helicopter Configurations-Single Main Rotor/Tail Rotor Configuration, Tandem Rotors, Coaxial Rotors, Side-By-Side Rotors, Intermeshing Rotors; Main Rotor System-Fully Articulated, Semi-Rigid and Rigid Rotor Systems, Combination Rotor Systems, Swash Plate Assembly, Anti-Torque Systems-Tail Rotor, Fenestron, NOTAR; Helicopter Controls: Collective Pitch Control, Cyclic Pitch Control, Anti-Torque Pedals, Throttle Control

**UNIT- II**

**Fundamentals of Rotor Aerodynamics:** Momentum Theory Analysis in Hovering Flight, Disk Loading and Power Loading, Induced Inflow Ratio, Thrust and Power Coefficients, Comparison of Theory with Measured Rotor Performance, Non-Ideal Effects on Rotor Performance, Figure of Merit, Induced Tip Loss, Rotor Solidity and Blade Loading Coefficients, Momentum Analysis in Axial Climb and Descent, Momentum Analysis in Forward Flight

**UNIT III**

**Blade Element Analysis, Rotating Blade Motion:** Blade Element Analysis in Hover and Axial flight, Forward Flight; Rotating Blade Motion-Introduction, Types of rotors, Equilibrium about the flapping hinge and lead-lag hinge, Equations of motion for a flapping blade, Blade feathering and the swash plate,

**UNIT-IV**

**Helicopter Performance:** Introduction, Hovering and Axial Climb Performance, Forward Flight Performance, Performance Analysis, Auto-Rotational Performance, Vortex Ring State, Ground Effect, Performance in Maneuvering Flight, Factors Influencing Performance Degradation

**UNIT-V**

**Aerodynamic Design of Helicopters:** Introduction, Overall Design Requirements, Conceptual and Preliminary Design Processes, Design of the Main Rotor, Fuselage Aerodynamic Issues, Empennage Design, Role of Wind Tunnels in Aerodynamic Design, Design of Tail Rotors, Other Ant-Torque Devices, High-Speed Rotorcraft

**TEXT BOOKS**

1. Principles of Helicopter Aerodynamics, 2<sup>nd</sup> edition, J. Gordon Leishman, Cambridge University Press, 2006

**REFERENCES:**

1. Rotorcraft Aeromechanics, Wayne Johnson, Cambridge University Press, 2013
2. Aerodynamics of the Helicopter, Alfred Gessow and Garry C. Myers, Jr., Frederic Ungar Publishing Co, New York, 1985
3. Fundamentals of Helicopter Dynamics, C. Venkatesan, CRC Press, 2015
4. The Art of the Helicopter, John Watkinson, Elsevier, 2004
5. Helicopter Performance, Stability and Control, Raymond W. Prouty, Krieger Publishing Company, 1986
6. Basic Helicopter Aerodynamics, 3<sup>rd</sup> edition, John Seddon and Simon Newman, Wiley, 2011
7. Helicopter Engineering, Lalit Gupta, M. R. Sivaraman, Himalaya Publishing House, 2015

**FABRICATION AND MACHINING OF COMPOSITE STRUCTURES**  
(PROFESSIONAL ELECTIVE – V)

**B.Tech. IV Year II Sem.**  
**Course Code: AE852PE**

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

**UNIT – I**

**Overview and Introduction:** Definition of composite material, Classification based on matrix and topology, Classification and characteristics of composites, Conventional vs. Composite materials, Advantages and limitations, Salient applications in various fields Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites. Classification of Polymers Properties of Thermo plastics Properties of Thermosetting Plastics, prepreg layup and autoclave processing.

**UNIT - II**

**Fibers and Matrix Materials:** Fibers Fabrication, Structure, properties and applications Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers whiskers Fabrication of Matrix materials polymers, metals and ceramics and their properties interfaces Wettability Types of bonding at the interface Tests for measuring interfacial strength Physical and chemical properties.

**UNIT - III**

**Processing of Polymer Matrix, Metal Matrix and Ceramic Matrix Composites:** Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer molding, autoclave molding bag molding, compression molding with Bulk Molding Compound and sheet Molding Compound thermoplastic matrix composites film stacking, diaphragm forming, thermoplastic tape laying, injection molding interfaces in PMCs structure, properties and application of PMCs recycling of PMCs.  
Metallic matrices: aluminum, titanium, magnesium, copper alloys processing of MMCs: liquid state, Solid state, in situ fabrication techniques diffusion bonding powder metallurgy techniques interfaces in MMCs.  
Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process in situ chemical reaction techniques: chemical vapor deposition, chemical vapor impregnation, solgel interfaces in CMCs.

**UNIT - IV**

**Conventional Machining, Mechanics of Operation and Chip Formation:** Requirement for machining FRPs, turning, single point cuttings, milling and trimming, drilling. Abrasive cutting, surface finish, fundamental considerations: orthogonal machining, machining of polymers, machining of unidirectional FRPs: chip formation modes, cutting forces, machining of multidirectional laminates: chip formations, cutting forces, modeling of the chip formation process: shear plane models, mechanics model of Zhang, mechanistic modeling.

## **UNIT - V**

### **Nontraditional machining of FRPS and health and safety aspects in machining FRPS:**

Abrasive water jet machining, laser machining, electric discharge machining. Hazard sources and route exposure, Dust generation in dry machining, aerosol emission in laser machining, work place control.

**Expected Results:** At the end of this course student would be in a position to work on advance research and development projects on composite materials and its fabrication

### **TEXT BOOKS:**

1. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.
2. Jamal Y. Sheikh ahmad, Machining of polymer composites, International Edition, Springer 2009.
3. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.

### **REFERENCES:**

1. Mechanics of Composite Materials, Autar\_K.\_Kaw, 2006 by Taylor & Francis Group, LLC.
2. Mechanics of laminated composite plates and shells theory and Analysis, 2<sup>nd</sup> ed., J.N Reddy, 2004 by CRC Press LLC.

**AIRLINES PLANNING, SCHEDULING AND OPERATIONS**  
**(PROFESSIONAL ELECTIVE – V)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE853PE**

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

**UNIT - I**

**Airline Economics, Markets and Demand:** Airline Terminology and Definitions-basic airline profit equation, Air transportation markets, Origin-Destination market demand, Air travel demand models, Airline competition and market share; Airline Pricing Theory and Practice: Airline prices and O-D markets, airline differential pricing, recent trends in airline pricing, airline pricing strategies; Airline Revenue Management: Computerized Revenue Management Systems, Flight Overbooking, EMSR Model for flight leg revenue optimization, network revenue management, revenue management for less restricted fare structures ; Airline operating Costs: Airline cost categorization, operating expense comparisons, comparison of airline unit costs; Measures of airline productivity: aircraft productivity and labour productivity

**UNIT - II**

**The Airline Planning Process:** Fleet Planning-airline fleet decisions, fleet planning methods; Route Planning- Hub economics and network structure, Route planning and evaluation; Airline Schedule Development-Frequency planning, time table development, fleet assignment and aircraft rotations; Integrated airline planning

**UNIT - III**

**Airline Schedule Optimization:** Schedule optimization problems, Fleet Assignment-The fleet assignment problem, fleet assignment solutions/impacts, extending basic fleet assignment models, Schedule Design optimization-Modeling the optimization of flight retiming and fleet assignment problems, importance of modelling competition in schedule design; Crew Scheduling- The crew pairing problem, crew scheduling problem solutions and impacts; Aircraft Maintenance Routing and crew pairing optimization, Future directions for schedule optimization

**UNIT - IV**

**Airline Flight Operations:** Regulation and scheduling-General regulatory requirements, flight crew regulation and Training, flight crew scheduling, Flight crew activities during a typical flight-flight crew sign-in, operations/planning, pre-flight, pre-departure, gate departure, taxi-out, take off, terminal area departure, climb, cruise, descent, terminal area arrival, final approach, landing rollout, taxi-in, parking, post-flight

**UNIT - V**

**Irregular Operations: Schedule Recovery and Robustness:** Irregular operations: Managing irregular operations- Airline operations control centers, options for schedule recovery from irregular operations, Schedule recovery from irregular operations: objectives

and process, Evaluating the costs of recovery options: The challenges imparted by uncertainty and downstream effects; Robust Airline Scheduling: Robust schedule design, robust fleet assignment, robust aircraft routing, robust crew scheduling

**TEXT BOOK:**

1. Peter Belobaba, Amedeo Odoni, Cynthia Barnhart (Editors), The Global Airline Industry, Second Edition, Wiley (2016),

**HYPersonic AERODYNAMICS**  
**(PROFESSIONAL ELECTIVE – V)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE854PE**

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

**UNIT - I**

**Introduction:** History of hypersonic flight- a logical progression in the light of advancing technical findings. Hypersonic flow- definition, importance, physical aspects. Brief descriptive introductory pre-view of various phenomena such as Thin shock layer, Entropy layer, Viscous interaction, Effects of high temperature and communication black out. Low density flow, free molecular flow.

**Hypersonic Shock and Expansion Wave Relations:** Oblique shock relations for high Mach numbers, Expansion wave relations for high Mach numbers. Theoretical basis of Mach number independence principle- corroboration by experimental results. Importance of experiments.

**UNIT- II**

**Local Surface Inclination Methods:** Newtonian flow and the hypersonic double limit of  $M \rightarrow \infty$  &  $\gamma \rightarrow 1$ , Modified Newtonian flow, Centrifugal force correction to Newtonian flow, Tangent wedge and tangent cone methods.

**Hypersonic Inviscid Flows - I:** Hypersonic small disturbance theory, Equivalence principle and hypersonic similarity parameter; Hypersonic shock relations in terms of similarity parameter.

**UNIT-III**

**Hypersonic Inviscid Flows – II:** Application of small disturbance theory and equivalence of 1-dimensional piston motion with 2-dimensional hypersonic flow, Flat plate at an angle of attack by piston theory and comparison with exact shock expansion method, Bi-convex airfoil at zero angle of attack: comparison of piston theory and exact shock expansion method, Phenomenological aspects of hypersonic blunt body problem, Importance of blunt body problem and brief outline of computational time-marching finite difference method and its advantage over other methods.

**UNIT– IV**

**Viscous Flows:** Derivation of compressible boundary layer equations, Brief introduction to the flat plate case and some important results and conclusions for high Mach number flows, Special characteristics of hypersonic boundary layers, Introduction to hypersonic interaction parameters – weak & strong.

**UNIT– V**

**Shock Tube Based Experimental Facilities:** Shock tunnel, Gun tunnel, Free piston wind tunnel, Ludweig tube, Measurement techniques, Samples of comparison of experimental and theoretical results.



**Other Hypersonic Facilities:** Continuous hypersonic tunnel free flight experiments in tunnels and ballistic ranges- Measurement techniques. Role of experiments in computer code validation and calibration, Brief introduction to heat transfer measurements.

**TEXT BOOKS:**

1. Anderson J D, *Hypersonic and High Temperature Gas Dynamics*, 2<sup>nd</sup> Edition, AIAA Education series, 2000.
2. Bertin, J. J. , *Hypersonic Aerothermo-dynamics*, AIAA Education series, 1994.
3. Spurk, J., *Fluid Mechanics*, Springer, Heidelberg, 1997.

**REFERENCES:**

1. Hayes W. D. and Probstein R. F., *Hypersonic Flow Theory*, Academic Press, 1959
2. Wendt J F, *European Hypersonic Wind Tunnels*, AGARD Conference Proceedings No. 428, Nov. 1987, Paper 2.
3. Canning T. N., Seiff A. and James, C. S., *Ballistic Range Technology*, AGARDograph Report AD 07 13915, Aug. 1970.
4. Brun, Raymond, *Introduction to Reactive Gas Dynamics*, Oxford Univ. Press, 2009, Chapter 11: Facilities and Experimental Methods.
5. Davies, H.J. and Churchack, H.D., *Shock Tube Techniques & Instrumentation*, 1969, US Army Material Command, Harry Diamond Lab, Washington DC (available on net – Free Copy).
6. Burtschell, Y., Brun, R., and Zeitoun, D., *Shock Waves*, Springer Verlag, Berlin , 1992.
7. *An Album of Supersonic Flow Visualization*, Edited by P I Kovalev & N P Mende, National Defense Industry Press (Write to Prof S V Bobashev, 26 Politechnicheskaya Street, St. Petersburg 194021, Russia).
8. Curtis, P. *Shock tubes*, Pegasus Eliot Mackenzie Publishers, October 2004.

**AEROELASTICITY**  
**(PROFESSIONAL ELECTIVE-VI)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE861PE**

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

**UNIT – I**

**Introduction to Aeroelasticity:** Collar's aeroelastic triangle, interaction of aerodynamic, structural and inertial forces, static aeroelasticity phenomena, dynamic aeroelasticity phenomena, aeroelastic problems at transonic speeds, aeroelastic tailoring, active flutter suppression.

**UNIT - II**

**Structural Dynamic Aspects:** Generalized coordinates and generalized forces, Strain energy, kinetic energy and dissipation function, Lagrange's equations of motion, Formulations of structural dynamics equation, Hamilton's principle, and orthogonality conditions.

**UNIT - III**

**Steady and Unsteady Aerodynamic Aspects:** Small perturbation theory, Two-dimensional unsteady flow over wings, simple harmonic motion, Theodorsen's function, arbitrary motion and Wagner function, gust problem, Küssner function.

**UNIT - IV**

**Static Aeroelastic Problems:** Static aeroelastic studies using strip theory - divergence, control effectiveness and control reversal; slender straight wing and swept wings, Static aeroelastic problems of low aspect ratio wings.

**UNIT - V**

**Dynamic Aeroelastic Phenomenon – Flutter:** Formulation of aeroelastic equations for a typical section, Torsion-flexure flutter – solution of flutter determinant, Method of determining the classical flutter speed using Theodorsen's and U-g methods.

**TEXT BOOKS:**

1. Wright, J.R., and Cooper, J.E., Introduction to Aircraft Aeroelasticity and Loads, John Wiley and Sons Ltd, 2007.
2. Bisplinghoff, R. L., Ashley, H. and Halfman, R. L., Aeroelasticity, Addison-Wesley Publishing Company, Cambridge, Mass., 1955., Dover Pub., Inc., 1996, (BAH).
3. Fung, Y.C., An Introduction to the Theory of Aeroelasticity, Dover Publication, Inc., 1969.
4. Scanlan, R.H., and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, The MacMillan Co., 1962.

**REFERENCES:**

1. Försching, H.W., Grundlagen der Aeroelastik, Springer-Verlag, 1974. (Excellent book, written in German but easy to understand)
2. Bisplinghoff, R. L., and Ashley, H., *Principles of Aeroelasticity*, John Wiley and Sons, Inc., New York, N.Y., 1962. Also available in Dover Edition. (BA)
3. AGARD Manual on Aeroelasticity, Vols. I-VII, Beginning 1959 with continual updating. (AGARD)
4. Broadbent, E.G., *The Elementary Theory of Aeroelasticity*, Aircraft Engineering, 1954.

**WIND ENGINEERING AND INDUSTRIAL AERODYNAMICS  
(PROFESSIONAL ELECTIVE - VI)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE862PE**

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

**UNIT - I**

**Atmospheric Winds and Atmospheric Boundary Layer:** Causes of wind thermal drive, Coriolis effect, pressure gradient effect, Geostrophic winds. Land and sea breeze, mountain winds, thermals, cause of turbulence at ground level. Atmospheric boundary layer, velocity profile laws-effects of terrain on atmospheric boundary Layer. Wind tunnels basic features and components. Wind tunnel models-role of non-dimensional groups. Creation of atmospheric boundary Layer type flow in a wind tunnel.

**UNIT - II**

**Wind Energy:** Ship propulsion-sails-lift and drag translators-modern yachts. Horizontal (HAWT) and vertical axis (VAWT) wind turbines-history, first example of automatic feedback control for yaw in 16<sup>th</sup> century English windmills, classification. Horizontal axis wind turbine (HAWT- elementary actuator disc theory-Betz coefficient. Definition of power coefficient & torque coefficient for all wind turbines. Working principle, power coefficients, tip speed ratio explanation: by introductory blade element theory- conventional horizontal axis wind turbine (HAWT), savonius vertical axis wind turbine (VAWT), Darrieus VAWT, merits and demerits of HAWTs and VAWTs.

**UNIT - III**

**Vehicle Aerodynamics:** relative importance of rolling resistance and aerodynamics resistance, power requirements and drag coefficients of automobiles-notch front and notch rear wind screens versus streamlined shape, Causes of vortex formation and drag—attached transverse vortex, trailing vortex, trailing vortex drag-effect of floor height on lift, effects of cut bank angle, rear end taper: side panels and bottom. Effects of chamfering of edges and cambering of roof & side panels. Racing cars-traction and steering strip and use of aerofoils, high cornering speed. Commercial transport vehicles-drag reduction on buses and trucks; driver cabin and trailer combinations.

**UNIT- IV**

**Building Aerodynamics:** Use of light weight components in modern buildings, pressure distribution on low-rise buildings, wind forces on buildings-aerodynamics of flat plate and circular cylinder, critical Reynold's no, sub-, super- & ultra critical Reynold's No. Role of wind tunnel requirements in determining shape factors (Drag coefficients) of building/structure shapes such as circular cylinder (chimneys & towers), rectangle, I-shape, L-shape, H-shape etc. vortex shedding & transverse oscillating loads. Slenderness ratio & correction factor. Special problems of tall buildings, interference effect of building.

**UNIT-V**

**Flow Induced Vibrations:** Classification – vortex induced vibration & flow induced instability such as Galloping & Stall flutter. Effects of Reynolds number on wake formation of bluff shapes. Vortex induced vibration – experimental determination of strouhal numbers for different shapes such as circular cylinder, square, rectangle, L-shape ect, universal strouhal number, unsteady Bernoulli equation, concept of added mass, Resonance, fluid – structure interaction – effect of transverse cylinder motion on flow and wake, “lock-in” vortex shedding near resonant frequency, experimental evidence of cylindrical motion influencing flow and thereby reducing strength of shed vortices. Methods of suppression of vortex induced vibration. Galloping & Stall flutter – motion of one degree-of-freedom, quasi steady flow assumption, Aerodynamic damping, Galloping – force in the direction of plunging (transverse motion ) and positive force coefficient, critical speed, Galloping of transmission wire with winter ice, stall flutter of airfoils.

**TEXT BOOKS:**

1. Blevins R.D Flow Induced Vibrations, van Nostard, 1990.
2. Sachs. P. Wind Forces in Engineering, Pergamon press 1988.
3. Calvert N.G. Wind Power Principles, Charles Griffin & co. London, 1979.

**REFERENCES:**

1. Scorer R.S. Environmental Aerodynamics, Ellis Harword Ltd, England, 1978.
2. Sorvan, M. Aerodynamics Drag Mechanisms of Bluff Bodies and Road vehicles, plenum press, N.Y.1978.

**HEAT TRANSFER**  
**(Professional Elective: VI)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE863PE**

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

**Note:** Heat Transfer Data Book is permitted.

**Pre-requisite:** Thermodynamics

**Course Objectives:** To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

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

- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer
- Design of heat exchangers using LMTD and NTU methods

**UNIT – I**

**Introduction:** Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

**UNIT – II**

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

**One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

**UNIT – III**

**Convective Heat Transfer:** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham  $\Pi$  Theorem and method, application for

developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

#### **UNIT – IV**

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

**Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

**Heat Exchangers:** Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

#### **UNIT - V**

##### **Heat Transfer with Phase Change:**

**Boiling:** – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation –Nusselt’s Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

**Radiation Heat Transfer :** Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

##### **TEXT BOOKS:**

1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

##### **REFERENCE BOOKS:**

1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastida / Oxford

**GROUND VEHICLE AERODYNAMICS  
(PROFESSIONAL ELECTIVE - VI)**

**B.Tech. IV Year II Sem.**  
**Course Code: AE864PE**

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

**UNIT - I**

**Overview and Introduction:** Historical developments and trends, fundamentals of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, Mechanics of air flow around a vehicle, pressure distribution, Aerodynamic forces, Vehicle drag and types, side and lift forces, cars as a bluff body, flow field around car, performance potential of vehicle aerodynamics.

**UNIT - II**

**Aerodynamic Drag and Shape Optimization of Cars:** Cars as a bluff body, flow field around a car, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles. Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear. Effect of rear configuration, effect of fasteners

**UNIT - III**

**Vehicle Handling and Stability:** Origin, characteristics and effects of forces and moments on a vehicle, lateral stability problems, vehicle dynamics under side winds-dirt accumulation on the vehicle, wind noise- Mechanisms and generation design features, measurement and techniques.

**UNIT - IV**

**Race Car Aerodynamics:** Basic vehicle body concepts, aerodynamics of the complete vehicle, flow over wheels, sliding seal, and skirts, under body channels, simple add ons: spoilers, strakes and wickers, internal flow, Race car wings, most current examples in detail-design, aerodynamic behavior, and flow field.

**UNIT - V**

**Measurement and Test Techniques:** Wind tunnel- scope, Fundamental techniques, simulation limitations, prototype tests, wind tunnel types and testing methods, Test techniques- scope, measuring equipment and transducers, road testing methods.

**TEXT BOOKS:**

1. Wolf- Heinrich Hucho, Aerodynamics of Road vehicles, SAE International 1998 A. Pope- "Wind Tunnel Testing"- John wiley & sons- 2<sup>nd</sup> Edition, New York- 1974
2. Katz, J., Race Car Aerodynamics Designing for Speed, Bentley Publishers

**REFERENCES:**

1. Automotive Aerodynamics: Update SP-706- SAE- 1987
2. Vehicle Aerodynamics – SP-1145- SAE-1996



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

**B.Tech. III Year I Sem.**  
**Course Code: AE5110E**

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

**UNIT - I**

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

**UNIT- II**

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

**UNIT-III**

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

**UNIT - IV**

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

**UNIT-V**

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

**TEXT BOOK:**

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

**REFERENCES**

1. ‘Rocket Propulsion and Space flight dynamics’, Cornelisse JW, Schoyer HFR, and Wakker KF, Pitman, 1984
2. ‘Fundamentals of Space Systems’, Vincet L. Pisacane, Oxford University Press, 2005.
3. ‘Understanding Space: An Introduction to Astronautics’, J. Sellers, 2<sup>nd</sup> edition, McGraw- Hill, 2004
4. ‘Introduction to Space Flight’, Francis J Hale, Prentice-Hall, 1994
5. ‘Spacecraft Mission Design’, Charles D. Brown, AIAA Education Series, 1998
6. ‘Elements of Space Technology for Aerospace Engineers’, Meyer Rudolph X, Academic Press, 1999

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

**UNIT – IV**

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

**UNIT – V**

**Satellite Systems Engineering Human Space Exploration:** Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, The Soviet and US missions; The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle; International Space Station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, Flight safety; Indian effort in aviation, missile and space technology.

**TEXT BOOKS:**

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

**REFERENCES**

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

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

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

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

**UNIT- I**

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

**UNIT-II**

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

**UNIT- III**

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

**UNIT- IV**

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

**UNIT - V**

**Airlines:** Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, computerized reservation systems, yield management. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

**TEXT BOOK:**

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

**REFERENCES:**

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

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

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

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

**UNIT- I**

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

**UNIT – II**

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

**UNIT – III**

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

**UNIT - IV**

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

**UNIT - V**

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

**TEXT BOOKS:**

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

**REFERENCES**

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

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

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

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

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

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

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

**UNIT - I**

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

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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



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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

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

**UNIT – IV**

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

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

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

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

**TEXT BOOKS & REFERENCES:**

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

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

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

**L T P C**

**Course Code: EM614PE/MT621OE**

**3 0 0 3**

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT- I**

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

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

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

**UNIT- II**

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

### **UNIT- III**

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

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

### **UNIT- IV**

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

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

### **UNIT- V**

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

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

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

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

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

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

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

**Course Objectives:**

- To understand the 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, Adaptation, Statistical Nature of the Learning Process

**UNIT - II**

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

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

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

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

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

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

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

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

**UNIT – I**

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

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

**UNIT – II**

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

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

**UNIT – III**

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

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

#### **UNIT – IV**

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

#### **UNIT – V**

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

#### **TEXT BOOKS:**

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

#### **REFERENCE BOOKS:**

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



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

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

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

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT - I**

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

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

**UNIT - II**

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

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

**UNIT – III**

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

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

**UNIT – IV**

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

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

#### **UNIT – V**

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

#### **TEXT BOOKS:**

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

#### **REFERENCE BOOKS:**

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

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

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

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

**Prerequisite:** Mathematics III

**Course Objectives:**

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

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

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

**UNIT – I**

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

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

**UNIT – II**

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

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

**UNIT – III**

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

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

**UNIT – IV**

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

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

**UNIT – V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOK:**

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

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

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

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

**Pre-requisites:** Nil.

**UNIT - I**

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

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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

**TEXT BOOKS:**

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

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

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

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

**Pre-requisites:** Nil.

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

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

**UNIT – I**

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

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

**UNIT – II**

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

TDM - PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

**UNIT – III**

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

**Modern Telemetry:** Zigbee, Ethernet.

**UNIT – IV**

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

**UNIT – V**

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

**TEXT BOOKS:**

1. Telemetry Principles – D. Patranabis, TMH

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

**REFERENCE BOOKS:**

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

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

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

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

**Course Objectives:**

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

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

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

**UNIT – I**

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

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

**UNIT - II**

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

**UNIT - III**

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

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

**UNIT – IV**



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

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

#### **UNIT - V**

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

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

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

#### **TEXT BOOKS:**

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

#### **REFERENCES:**

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

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

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

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

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

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

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

**UNIT - I**

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

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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

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

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

**Pre Requisites:** Surveying

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

#### **UNIT – IV**

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

#### **UNIT – V**

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

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

#### **TEXT BOOKS:**

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

#### **REFERENCES:**

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

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

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

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

**Course Objectives:**

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

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

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

**UNIT – I**

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

**UNIT - II**

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

**UNIT – III**

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

**UNIT - IV**

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

**UNIT - V**

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

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

**UNIT – IV**

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

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

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

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

**TEXT BOOKS & REFERENCES:**

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



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

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

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

**Pre Requisites:** Environmental Engineering

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

**Course Outcomes:**

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

**UNIT – I**

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

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

**UNIT- II**

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

**UNIT- III**

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

**UNIT – IV**

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

## **UNIT - V**

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

### **TEXT BOOKS:**

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

### **REFERENCES:**

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

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

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

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

**Prerequisites:** Operations Research

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

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

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

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

**UNIT - I**

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

**UNIT - II**

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

**UNIT - III**

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

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

#### **UNIT - IV**

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

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

#### **UNIT - V**

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

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

#### **TEXT BOOKS:**

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

#### **REFERENCES:**

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

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

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

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

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

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

**Unit – 1: Entrepreneurial Perspectives:**

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

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

**Unit – 2: New Venture Creation:**

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

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

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

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

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

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

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

**Text Books:**

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

**REFERENCES:**

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

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

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

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

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

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

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

**UNIT - I**

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

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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



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

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

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

**Pre Requisites:** Environmental Engineering

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

**Course Outcomes:**

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

**UNIT – I**

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

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

**UNIT- II**

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

**UNIT- III**

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

**UNIT – IV**

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

## **UNIT - V**

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

### **TEXT BOOKS:**

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

### **REFERENCES:**

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

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

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

**UNIT – IV**

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

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

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

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

**TEXT BOOKS & REFERENCES:**

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

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

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

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

**Pre Requisites:** Surveying

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

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

#### **UNIT – IV**

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

#### **UNIT – V**

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

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

#### **TEXT BOOKS:**

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

#### **REFERENCES:**

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

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

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

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

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

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

**Unit – 1: Entrepreneurial Perspectives:**

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

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

**Unit – 2: New Venture Creation:**

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

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

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

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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

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

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

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT - I**

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

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

**UNIT - II**

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

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



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

### **UNIT - III**

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

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

### **UNIT - IV**

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

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

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

### **UNIT - V**

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

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

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

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

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

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

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

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT - I**

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

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

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

**UNIT - II**

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

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

### **UNIT - III**

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

### **UNIT - IV**

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

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

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

### **UNIT - V**

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

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

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

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

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

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

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

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

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT- I**

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

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

**UNIT- II**

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

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

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

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

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

### UNIT- III

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

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

### UNIT- IV

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

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

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

### UNIT- V

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

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

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

### TEXT BOOK:

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

### REFERENCE BOOKS:

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

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

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

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

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT - I**

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

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

**UNIT - II**

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

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

**UNIT - III**

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

**UNIT-IV**

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

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

**UNIT - V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

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

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

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

**UNIT- I**

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT IV**

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

**UNIT V**

**Cyber Security:** Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**TEXT BOOK:**

1. **Cyber Security:** *Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Nina Godbole and Sunil Belapure, Wiley INDIA.



**REFERENCE BOOK:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press  
T&F Group

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

**B.Tech. IV Year II Sem.**  
**Course Code: CS831OE**

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

**Course Objectives:**

- To understand and make effective use of Linux utilities and Shell scripting language (bash) to solve Problems.
- To implement in C some standard Linux utilities such as ls, mv, cp etc. using system calls.
- To develop the skills necessary for systems programming including file system programming, process and signal management, and interprocess communication.
- To develop the basic skills required to write network programs using Sockets.

**Course Outcomes:**

- Work confidently in Linux environment.
- Work with shell script to automate different tasks as Linux administration.

**UNIT- I**

**Linux Utilities** - File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities.

Sed-Scripts, Operation, Addresses, Commands, Applications, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.

**Shell programming with Bourne again shell (bash)** - Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

**UNIT- II**

**Files and Directories** - File Concept, File types, File System Structure, file metadata-Inodes, kernel support for files, system calls for file I/O operations- open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking-fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links – symlink, link, unlink. **Directories** - Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT- III**

**Process** – Process concept, Layout of a C program image in main memory, Process environment-environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process, system call interface for process management-fork, vfork, exit, wait, waitpid, exec family, Process Groups, Sessions and Controlling Terminal, Differences between threads and processes.

**Signals** – Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions.

**UNIT- IV**

**Interprocess Communication** - Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pipes-creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs (Named pipes), differences between unnamed and named pipes, popen and pclose library functions. **Message Queues** - Kernel support for messages, APIs for message queues, client/server example. **Semaphores** - Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

**UNIT- V**

**Shared Memory** - Kernel support for shared memory, APIs for shared memory, shared memory example. **Sockets** - Introduction to Berkeley Sockets, IPC over a network, Client-Server model, Socket address structures (Unix domain and Internet domain), Socket system calls for connection oriented protocol and connectionless protocol, example-client/server programs-Single Server-Client connection, Multiple simultaneous clients, Socket options-setsockopt andfcntl system calls, Comparison of IPC mechanisms.

**TEXT BOOKS:**

1. Unix System Programming using C++, T. Chan, PHI.
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Unix Network Programming, W. R. Stevens, PHI.

**REFERENCE BOOKS:**

1. Beginning Linux Programming, 4<sup>th</sup> Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
2. Unix for programmers and users, 3<sup>rd</sup> Edition, Graham Glass, King Ables, Pearson.
3. System Programming with C and Unix, A. Hoover, Pearson.
4. Unix System Programming, Communication, Concurrency and Threads, K. A. Robbins and S. Robbins, Pearson Education.
5. Unix shell Programming, S. G. Kochan and P. Wood, 3<sup>rd</sup> edition, Pearson Education.
6. Shell Scripting, S. Parker, Wiley India Pvt. Ltd.

7. Advanced Programming in the Unix Environment, 2<sup>nd</sup> edition, W. R. Stevens and S. A. Rago, Pearson Education.
8. Unix and Shell programming, B. A. Forouzan and R. F. Gilberg, Cengage Learning.
9. Linux System Programming, Robert Love, O'Reilly, SPD.
10. C Programming Language, Kernighan and Ritchie, PHI

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

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

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

**Course Objectives:**

- Understanding and being able to use basic programming concepts
- Automate data analysis
- Working collaboratively and openly on code
- Knowing how to generate dynamic documents
- Being able to use a continuous test-driven development approach

**Course Outcomes:**

- be able to use and program in the programming language R
- be able to use R to solve statistical problems
- be able to implement and describe Monte Carlo the technology
- be able to minimize and maximize functions using R

**UNIT – I**

**Introduction:** Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

**UNIT – II**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

**Vectors:** Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

**UNIT – III**

**Lists:** Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

**UNIT - IV**

FACTORS AND TABLES, Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

**UNIT - V**

**OBJECT-ORIENTED PROGRAMMING:** S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

**TEXT BOOKS:**

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth singh, Vivek Mourya, Cengage Learning India.

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

**B.Tech. IV Year II Sem.**  
**Course Code: CS833OE**

L	T	P	C
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:**

1. **Beginning PHP, Apache, MySQL Web Development** - Elizabeth Naramore, Jason Gerner, Yann Le, Scouarnec, Jeremy Stolz, Michael K. Glass, Gary Mailer - By Wrox Publication.
2. **PHP, MySQL and Apache** - Julie C. Melone By Pearson Education

**REFERENCE BOOKS:**

1. **Beginning PHP 5.3**, by Matt Doyle - By Wrox Publication
2. **PHP and MySQL Bible** – Tim Converse and Joyce Park with Clark Morgam By Wiley INDIA



**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
PRINCIPLES OF ELECTRONIC COMMUNICATIONS  
(OPEN ELECTIVE - I)**

**B.Tech. III Year I Sem.**  
**Course Code: EC511OE**

**L T P C**  
**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**

**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

**UNIT - III**

**Telecommunication Systems:** Telephones Telephone system, Paging systems, Internet Telephony.

**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

**UNIT - IV**

**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT - V**

**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.

**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**Text Books:**

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL EDUCATION, 1999

**Reference Books:**

1. Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
3. Introduction to data communications and networking, Wayne Tomasi, Pearson Education, 2005.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: EC621OE**

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

**Course Objectives:**

1. To understand the concept of computer communication.
2. To learn about the networking concept, layered protocols.
3. To understand various communications concepts.
4. To get the knowledge of various networking equipment.

**Course Outcomes:**

1. The student can get the knowledge of networking of computers, data transmission between computers.
2. Will have the exposure about the various communication concepts.
3. Will get awareness about the structure and equipment of computer network structures.

**UNIT - I**

**Overview of Computer Communications and Networking:** Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

**UNIT - II**

**Essential Terms and Concepts:** Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

**UNIT - III**

**Analog and Digital Communication Concepts:** Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction, Digital Carrier Systems.

**UNIT - IV**

**Physical and data link layer Concepts:** The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

**UNIT - V**

**Network Hardware Components:** Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

**TEXT BOOKS:**

1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.
2. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition MC GRAW HILL EDUCATION, 2006.

**REFERENCE BOOKS:**

1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.
2. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3<sup>rd</sup> Edition, Pearson Education.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING  
/ B.TECH ELECTRONICS AND TELEMATICS ENGINEERING  
ELECTRONIC MEASURING INSTRUMENTS  
(OPEN ELECTIVE - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EC831OE**

**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**

**Block Schematics of Measuring Systems and Performance Metrics:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag.

**UNIT - II**

**Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, and Specifications.

**UNIT - III**

**Measuring Instruments:** DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments. CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes.

**UNIT - IV**

**Recorders:** X-Y Plotter, Curve tracer, Galvanometric Recorders, Servo transducers, pen driving mechanisms, Magnetic Recording, Magnetic recording techniques.

**UNIT - V**

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

**TEXT BOOKS:**

1. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2<sup>nd</sup> Edition 2004.

**REFERENCES:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbins, W.D. Cooper: PHI 5<sup>th</sup> Edition 2003.
3. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

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

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

L	T	P	C
3	0	0	3

**Course Objectives:** The goal of the course is to study:

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment.
- Usage of scripting languages in IC design flow.

**Course Outcomes:**

Upon learning the course, the student will have the:

- Ability to create and run scripts using PERL/TCL/Python in IC design flow.
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.

**UNIT –I:**

**Linux Basics:**

Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

**UNIT –II :**

**Linux Networking:**

Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

**UNIT –III :**

**Perl Scripting:**

Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

**UNIT –IV:**

**Tcl / Tk Scripting:**

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Eval, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

**UNIT –V :**

**Python Scripting:**

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

**TEXT BOOKS:**

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
3. Teach Yourself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

**REFERENCE BOOKS:**

1. Learning Python – 2<sup>nd</sup> Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3<sup>rd</sup> Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4<sup>th</sup> Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Python Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3<sup>rd</sup> Edition, O'Reilly, 2000. (ISBN 0596000278)



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

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

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

**Prerequisite:** Nil.

**Course Objectives:** This course makes the students to Understand

- Fundamentals of Neural Networks & Feed Forward Networks.
- Associative Memories & ART Neural Networks.
- Fuzzy Logic & Systems.
- Genetic Algorithms and Hybrid Systems.

**Course Outcomes:** On completion of this course the students will be able to

- Identify and employ suitable soft computing techniques in classification and optimization problems.
- Design hybrid systems to suit a given real – life problem.

**UNIT –I:**

**Fundamentals of Neural Networks & Feed Forward Networks:**

Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network (BPN), The Solution, Back propagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

**UNIT –II:**

**Associative Memories & ART Neural Networks:**

Basic concepts of Linear Associator, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks(HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

**UNIT –III:**

**Fuzzy Logic & Systems:**

Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller.

**UNIT –IV:**

**Genetic Algorithms:**

Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

**UNIT –V:**

**Hybrid Systems:**

Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation  
Dept. of ECE, JNTUHCEH M.Tech. (SSP) (FT) w.e.f. 2015-16 56 Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

**TEXT BOOKS:**

1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, July 2011, PHI, New Delhi.
3. Genetic Algorithms by David E. Goldberg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Systems- Kosko.B., PHI, Delhi,1994.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**  
**DATA ANALYTICS**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EM831OE**

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

**Prerequisite:** Nil

**Course Objectives:** The student should be made to :

- Be exposed to conceptual frame work of big data.
- Understand different techniques of Data Analysis.
- Be familiar with concepts of data streams.
- Be exposed to item sets, Clustering, frame works and Visualization.

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

- Understand Big data fundamentals.
- Learn various Data Analysis Techniques
- Implement various Data streams.
- Understand item sets, Clustering, frame works & Visualizations.

#### **UNIT – I**

**Introduction to Big Data:** Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability , analytic process and tools , Analysis vs Reporting – Modern data analytic tools, stastical concepts : Sampling distributions, resampling , statistical inference, prediction error.

#### **UNIT – II**

**Data Analysis:** Regression modeling , Multivariate analysis, Bayesian modeling , inference and Bayesian networks , Support vector and Kernel methods, Analysis of time series : Linear systems analysis , nonlinear dynamics – Rule induction – Neural networks : Learning and and Generalisation, competitive learning, Principal component analysis and neural networks ; Fuzzy Logic : extracting fuzzy models from data , fuzzy decision trees, Stochastic search methods.

#### **UNIT – III**

**Mining Data Streams:** Introduction to Streams Concepts – Stream data model and architecture – Stream Computing , Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform ( RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

#### **UNIT – IV**

**Frequent Itemsets and clustering:** Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

#### **UNIT – V**

**Frame Works and Visualization:** MapReduce – Hadoop, Hive , MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques : systems and Applications .

#### **TEXT BOOKS:**

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

#### **REFERENCE BOOKS:**

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**NON-CONVENTIONAL POWER GENERATION**  
**(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE511OE**

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

**Prerequisite:** Nil.

**Course Objectives:**

- To introduce various types of renewable energy technologies
- To understand the technologies of energy conversion from the resources and their quantitative analysis.

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

- Analyze solar thermal and photovoltaic systems and related technologies for energy conversion.
- Understand Wind energy conversion and devices available for it.
- Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies.
- Realize Power from oceans (thermal, wave, tidal) and conversion devices.
- Understand fundamentals of fuel cells and commercial batteries.

**UNIT - I**

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still.

**UNIT - II**

Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics- Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking - Solar Thermo electric conversion.

**UNIT - III**

Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit- Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems.

**UNIT - IV**

Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion - Factors affecting

generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers – Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

#### **UNIT - V**

OTEC Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves-Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Advantages and disadvantages - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

#### **TEXT BOOKS:**

1. “John Twidell & Wier”, “Renewable Energy Resources”, CRC Press, 2009.
2. “G. D. Rai”, “Non Conventional Energy sources”, Khanna publishers, 2004

#### **REFERENCE BOOKS:**

1. “D. P .Kothari, Singal, Rakesh and Ranjan”, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. “F. C. Treble”, Generating Electricity from Sun, Pergamon Press, 1<sup>st</sup> Edition 1991
3. “C. S. Solanki”, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009
4. “S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ELECTRICAL ENGINEERING MATERIALS**  
**(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE512OE**

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

**Prerequisite:** Engineering chemistry and Engineering Physics - II

**Course Objective:**

- To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

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

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Acquire Knowledge on Materials used in electrical engineering and applications.

**UNIT- I**

**Dielectric Materials:** Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

**UNIT – II**

**Magnetic Materials:** Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

**UNIT – III**

**Semiconductor Materials:** Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI)

**UNIT – IV**

**Materials for Electrical Applications:** Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

## **UNIT – V**

**Special Purpose Materials:** Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI

### **Text Books:**

1. “R K Rajput”, “ A course in Electrical Engineering Materials”, Laxmi Publications, 2009
2. “T K Basak”, “ A course in Electrical Engineering Materials”, New Age Science Publications 2009

### **Reference Books:**

1. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
2. “AdrianusJ.Dekker”, Electrical Engineering Materials, PHI Publication, 2006.
3. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & Sons, 2011.



**B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING  
NANOTECHNOLOGY  
(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EE513OE**

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

**Course Objectives:** Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

**Course Outcomes:** The present syllabus of “Introduction to Nano Technology” will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

**UNIT - I**

**Introduction:** History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

**UNIT - II**

**Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials:** Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

**Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

**Magnetic Properties:** Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

**UNIT- III**

**Synthesis Routes: Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders:** Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

**UNIT - IV**

**Tools to Characterize nanomaterials:** X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope

(STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

#### **UNIT - V**

**Applications of Nanomaterials:** Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

#### **TEXT BOOKS:**

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

#### **REFERENCES BOOKS:**

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
DESIGN ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE621OE**

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

**Prerequisite:** Power systems - I & Power Systems - II

**Course Objectives:**

- To emphasize the estimation and costing aspects of all electrical equipment, installation and designs on the cost viability.
- To design and estimation of wiring
- To design overhead and underground distribution lines, substations and illumination

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

- Understand the design considerations of electrical installations.
- Design electrical installation for buildings and small industries.
- Identify and design the various types of light sources for different applications.

**UNIT - I**

**Design Considerations of Electrical Installations:** Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections, Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

**UNIT - II**

**Electrical Installation for Different Types of Buildings and Small Industries:** Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.

**UNIT - III**

**Overhead and Underground Transmission and Distribution Lines:** Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

#### **UNIT - IV**

**Substations:** Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

#### **UNIT - V**

**Design of Illumination Schemes:** Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes LED, CFL and OCFL differences.

#### **Text Books:**

1. “K. B. Raina, S. K. Bhattacharya”, “Electrical Design Estimating and Costing”, New Age International Publisher, 2010.
2. “Er. V. K. Jain, Er. Amitabh Bajaj”, “Design of Electrical Installations”, University Science Press.

#### **Reference Books:**

1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650 volts), Indian Standard Institution, IS: 732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS: 4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding 650 V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthing, Indian Standard Institution, IS: 3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. “Gupta J. B., Katson, Ludhiana”, “Electrical Installation, estimating and costing”, S. K. Kataria and sons, 2013.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ENERGY STORAGE SYSTEMS**  
**(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE622OE**

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

**Prerequisite:** Electro chemistry

**Course Objective:**

- To enable the student to understand the need for energy storage, devices and technologies available and their applications

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

- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

**UNIT - I**

**Electrical Energy Storage Technologies:** Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

**UNIT - II**

**Needs for Electrical Energy Storage:** Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

**UNIT - III**

**Features of Energy Storage Systems:** Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H<sub>2</sub>), Synthetic natural gas (SNG).

**UNIT - IV**

**Types of Electrical Energy Storage systems:** Electrical storage systems, Double-layer capacitors (DLC) , Superconducting magnetic energy storage (SMES), Thermal storage systems , Standards for EES, Technical comparison of EES technologies.

## **UNIT - V**

**Applications:** Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA–aggregation of many dispersed batteries.

### **Text Books:**

1. “James M. Eyer, Joseph J. Iannucci and Garth P. Corey “, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

### **Reference Book:**

1. “Jim Eyer, Garth Corey”, Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING  
INTRODUCTION TO MECHATRONICS  
(OPEN ELECTIVE – II)**

**B.Tech. III Year II Sem.**  
**Course Code: EE623OE**

L	T	P	C
3	0	0	3

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

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

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

**UNIT – I**

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

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

**UNIT – II**

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

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

### **UNIT – III**

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

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

### **UNIT – IV**

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

### **UNIT – V**

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

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

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



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

**B.Tech. IV Year II Sem.**  
**Course Code: EE831OE**

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

**(Students must read text book. Faculty is free to choose any other cases)**

**Course Objectives:** It enables the student to understand the foundations of Enterprise planning and ERP System Options.

**Course Outcome:** The student understands the challenges in implementation of ERP system, ERP System Implementation options, and functional modules of ERP.

1. Introduction to ERP- Foundation for Understanding ERP systems-Business benefits of ERP-The challenges of implementing ERP system-ERP modules and Historical Development.

Case: Response top RFP for ban ERP system (Mary Sumner).

2. ERP system options & Selection methods-Measurement of project Impact-information Technology Selection-ERP proposal evaluation-Project Evaluation Technique.(David L. olson).

Case: Atlantic Manufacturing (Mary Sumner).

3. ERP system Installation Options- IS/IT Management results-Risk Identification analysis-System Projects- Demonstration of the system-Failure method-system Architecture & ERP (David L. Olson)

Case: Data Solutions & Technology Knowledge (Mary Sumner).

4. ERP - sales and Marketing- Management control process in sales and marketing - ERP customer relationship management - ERP systems- Accounting & Finance control processes. Financial modules in ERP systems.

Case: Atlantic manufacturing (Mary Sumner).

5. ERP – Production and Material Management-Control process on production and manufacturing - Production module in ERP- supply chain Management & e-market place-e-business & ERP-e supply chain & ERP- Future directions for ERP.

Case: HR in Atlantic manufacturing. (Mary Sumner).

### **UNIT - I**

**ERP and Technology:** Introduction – Related Technologies – Business Intelligence – E-Commerce and E Business – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM

### **UNIT - II**

**ERP Implementation:** Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks –Requirements Definition – Methodologies – Package selection –

Project Teams –Process Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities.

### **UNIT - III**

**ERP In Action & Business Modules:** Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance –Materials Management – Quality management – Marketing – Sales, Distribution and service.

### **UNIT - IV**

**ERP Market:** Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc –SSA Global – Lawson Software – Epicor – Intutive.

### **UNIT - V**

Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP.

### **TEXT BOOKS:**

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

### **REFERENCE BOOKS:**

1. Jim Mazzullo, “SAP R/3 for Everyone”, Pearson, 2007.
2. Jose Antonio Fernandz, “The SAP R /3 Handbook”, Tata McGraw Hill, 1998.
3. Biao Fu, “SAP BW: A Step-by-Step Guide”, First Edition, Pearson Education, 2003.

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

**B.Tech. IV Year II Sem.**  
**Course Code: EE832OE**

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

**Course Objective:**

- To provide the basic concepts of Enterprise Resource Planning and Management of Information System.
- Explain to students why information systems are so important today for business and management;
- Evaluate the role of the major types of information systems in a business
- Assess the impact of the Internet and Internet technology on business-electronic commerce and electronic business;
- Identify the major management challenges to building and using information systems and learn how to find appropriate solutions to those challenges

**Course Outcomes:** The completion of the subject, the student will be able to

- Understand the usage of MIS in organizations and the constituents of the MIS
- Understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
- Assess the requirement and stage in which the organization is placed. Nolan model is expected to aid such decisions
- Learn the functions and issues at each stage of system development. Further different ways in which systems can be developed are also learnt.

**UNIT – I**

**Introduction to IS Models and Types of Information systems:** – Nolan Stage Hypothesis, IS Strategic Grid, Wards Model, Earl's Multiple Methodology, Critical Success Factors, Soft Systems Methodology, Socio-Technical Systems Approach (Mumford), System Develop Life Cycle, Prototype and End User Computing, Application Packages, Outsourcing, Deciding Combination of Methods. Types of Information Systems

**UNIT – II**

**IS Security, Control and Audit**– System Vulnerability and Abuse, business value of security and control, Need for Security, Methods of minimizing risks IS Audit, ensuring system quality.

**UNIT – III**

**Induction to ERP:** Overview of ERP, MRP, MRPII and Evolution of ERP, Integrated Management Systems, Reasons for the growth of ERP, Business Modeling, Integrated Data

Model, Foundations of IS in Business, Obstacles of applying IT, ERP Market- ERP Modules: Finance, Accounting Systems, Manufacturing and Production Systems, Sales and Distribution Systems, , Human Resource Systems, Plant Maintenance System, Materials Management System, Quality Management System, ERP System Options and Selection, ERP proposal Evaluation.

#### **UNIT – IV**

**Benefits of ERP:** Reduction of Lead Time, On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.

#### **UNIT – V**

**ERP Implementation and Maintenance:** Implementation Strategy Options, Features of Successful ERP Implementation, Strategies to Attain Success, User Training, Maintaining ERP & IS. Case Studies.

#### **TEXT BOOKS:**

1. Gordon B. Davis & Margrethe H. Olson: Management Information Systems, TMH, 2009.
2. C Laudon and Jane P. Laudon, et al: Management Information Systems, Pearson Education, 2009.
3. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
4. C. S. V. Murthy: Management Information System, Himalaya, 2009
5. James A. Obrein: Management Information Systems, TMH, 2009
6. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
7. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
8. Vaman, ERP in Practice, TMH, 2009

#### **REFERENCE BOOKS:**

1. Dharminder and Sangeetha: Management Information Systems, Excel, 2009
2. Gerald V. Post, David L Anderson: Management Information Systems, Irvin McGraw Hill, 2009.
3. Monk: Concepts in ERP, Cengage, 2009
4. Olson: Managerial Issues of ERO, TMH, 2009
5. Motiwala: Enterprise Resource Planning, Pearson 2009
6. Miller: MIS—Cases, Pearson, 2009

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ORGANIZATIONAL BEHAVIOUR**  
**(OPEN ELECTIVE – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EE833OE**

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

**Course Objective:**

- To provide the students with the conceptual framework and the theories underlying Organisational Behaviour.

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

- Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
- Assess the potential effects of organizational level factors (such as structure, culture and change) on organizational behaviour.
- Critically evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behaviour.
- Analyse organizational behavioural issues in the context of organizational behaviour theories, models and concepts.

**UNIT – I**

Introduction to OB - Definition, Nature and Scope –Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour. Cognitive Processes-I : Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization - Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

**UNIT – II**

Cognitive Processes-II: Personality and Attitudes - Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organisational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

**UNIT – III**

Dynamics of OB-I: Communication – types - interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision making techniques – creativity and group decision making . Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of

conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.

#### **UNIT – IV**

Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups –dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

#### **UNIT – V**

Leading High performance: Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

#### **TEXT BOOKS:**

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4. Newstrom W. John & Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.
7. Pareek Udai: Behavioural Process at Work:, Oxford & IBH, New Delhi, 2009.

#### **REFERENCE BOOKS:**

1. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.
2. Hitt: Organizational Behaviour, Wiley, 2008
3. Aswathappa: Organisational Behaviour, Himalaya, 2009
4. Mullins: Management and Organisational Behaviour, Pearson, 2008.
5. McShane, Glinow: Organisational Behaviour--Essentials, TMH, 2009.
6. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: EI511OE**

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

**Prerequisite: Nil**

**Course Objectives:**

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

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

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

**UNIT - I**

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

**UNIT - II**

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

### **UNIT - III**

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

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

### **UNIT - IV**

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

### **UNIT - V**

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

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

### **TEXT BOOKS:**

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2<sup>nd</sup> Edition 2004.

### **REFERENCE BOOKS:**

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



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

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

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

**Pre-requisites:** Basic Electrical and Electronics Engineering or Electronic Devices and Circuits.

**UNIT - I**

**DC Amplifiers:** Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

**UNIT - II**

**Regulated Power Supplies:** Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection.

**Switched Mode & IC Regulators:** Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting .

**UNIT - III**

**SCR and Thyristor:** Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.

**UNIT - IV**

**Applications of SCR in Power Control:** Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave.

**DIAC, TRIAC and Thyristor Applications:** Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.

**UNIT - V**

**Industrial Applications - I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators.

Electric Welding Classification, types and methods of Resistance and ARC welding, Electronic DC Motor Control.

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

Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications.

**TEXTBOOKS:**

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

**REFERENCE BOOKS:**

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6<sup>th</sup> Edn., 2003.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.3.
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**SENSORS AND TRANSDUCERS**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EI831OE**

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

**Pre-requisites:** Nil

**Course Objectives:** To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities and the following:

- Various types of Sensors & Transducers and their working principle
- Resistive, Capacitive and Inductive transducers
- Some of the miscellaneous transducers
- Characteristics of transducers

**Course Outcomes:** Upon completion of this course the student shall be able to understand the working of basic sensors and transducers used in any industries.

**UNIT – I**

**Measurements and Instrumentation of Transducers:** Measurements – Basic method of measurement – Generalized scheme for measurement systems – Units and standards – Errors – Classification of errors, error analysis – Statistical methods – Sensor – Transducer – Classification of transducers – Basic requirement of transducers.

**UNIT – II**

**Characteristics of Transducers:** Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs

**UNIT – III**

**Resistive Transducers:** Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer

**UNIT – IV**

**Inductive and Capacitive Transducer:** Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

**UNIT – V**

**Miscellaneous Transducers:** Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers

**TEXT BOOKS:**

1. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Patranabis. D, “Sensors and Transducers”, Prentice Hall of India, 2003.

**REFERENCE BOOKS:**

1. Renganathan. S, “Transducer Engineering”, Allied Publishers, Chennai, 2003.
2. Doebelin. E.A, “Measurement Systems – Applications and Design”, Tata McGraw Hill, New York, 2000.
3. John. P, Bentley, “Principles of Measurement Systems”, III Edition, Pearson Education, 2000.
4. Murthy. D. V. S, “Transducers and Instrumentation”, Prentice Hall of India, 2001.
5. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
6. Instrument Transducers – An Introduction to their Performance and design – by Herman K. P. Neubrat, Oxford University Press.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**PC BASED INSTRUMENTATION**  
**(Open Elective – III)**

**B.Tech. IV Year II Sem.**  
**Course Code: EI832OE**

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

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

**UNIT – I**

**Introduction to Computer Instrument Communication:** Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.

**UNIT – II**

**Programmable logic controller (PLC) basics:** Definition, overview of PLC systems, input/output modules, power supplies, and isolators.

**Basic PLC programming:** Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

**UNIT – III**

**PLC intermediate and advanced functions:** Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

**UNIT – IV**

**Application of PLC:** Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating

**UNIT – V**

**Related Topics:** Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting, and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves, and smart actuators.

**TEXT BOOKS**

1. Programmable Logic Controllers – Principles and Applications, John. W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New Jersey, 1998.
2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

**REFERENCES**

1. PC Based Instrumentation and Control Third Edition by Mike Tooley ; Elsevier.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation, and Control. By Kevin James; Elsevier.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.
4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.
5. 5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, New York, 1997.
6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

**B.TECH. MECHANICAL ENGINEERING**  
**OPTIMIZATION TECHNIQUES**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: ME511OE**

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

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

**Course Objectives:**

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

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

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

**UNIT – I**

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

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

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

**UNIT – II**

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

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

### UNIT – III

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

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

### UNIT – IV

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

### UNIT – V

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

### TEXT BOOKS:

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

### REFERENCE BOOKS:

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



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

**B.Tech. III Year I Sem.**  
**Course Code: ME512OE**

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

**Course Objectives:**

- To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
- To make the student present the content graphically.

**Course Outcomes:**

- Students can animate scenes entertainment.
- Will be able work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

**UNIT - I**

**Introduction:** Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

**Output primitives:** Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

**UNIT - II**

**2-D Geometrical transforms:** Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

**2-D Viewing:** The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

**UNIT - III**

**3-D Object representation:** Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces, sweep representations, octrees BSP Trees,

**3-D Geometric transformations:** Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

#### **UNIT - IV**

**Visible surface detection methods:** Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

**Illumination Models and Surface rendering Methods:** Basic illumination models, polygon rendering methods

#### **UNIT- V**

**Computer animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

#### **TEXT BOOKS:**

1. "Computer Graphics C version", Donald Hearn and M. Pauline Baker, Pearson education.
2. "Computer Graphics Second edition", Zhigand xiang, Roy Plastock, Schaum's outlines, Tata Mc Graw hill edition.

#### **REFERENCE BOOKS:**

1. "Computer Graphics Principles & practice", second edition in C, Foley, Van Dam, Feiner and Hughes, Pearson Education.
2. "Procedural elements for Computer Graphics", David F Rogers, Tata Mc Graw hill, 2nd edition.
3. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
4. "Principles of Computer Graphics", Shalini, Govil-Pai, Springer.
5. "Computer Graphics", Steven Harrington, TMH
6. Computer Graphics, F. S. Hill, S. M. Kelley, PHI.
7. Computer Graphics, P. Shirley, Steve Marschner & Others, Cengage Learning.
8. Computer Graphics & Animation, M. C. Trivedi, Jaico Publishing House.
9. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor&Francis Group.
10. Computer Graphics, Rajesh K.Maurya, Wiley India.

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

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

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

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

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

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

**UNIT – I**

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

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

**UNIT – II**

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

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

### **UNIT – III**

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

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

### **UNIT – IV**

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

### **UNIT – V**

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

### **TEXT BOOKS:**

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

### **REFERENCE BOOKS:**

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

**B.TECH. MECHANICAL ENGINEERING**  
**FUNDAMENTALS OF MECHANICAL ENGINEERING**  
**(Open Elective - I)**

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

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

**Pre-Requisites:** None

**Course Objectives:** Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

**Course Outcomes:** After learning the course the students should be able to

- To understand the fundamentals of mechanical systems.
- To understand and appreciate significance of mechanical engineering in different Fields of engineering.

**UNIT - I**

**Introduction:** Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.

**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion.

**UNIT - II**

**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process

**Properties of Steam:** Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters.

**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

**UNIT - III**

**Heat Engines:** Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles.

**Internal Combustion Engines:** Introduction, Classification, Engine details, four- stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies.

**UNIT - IV**

**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming

**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistage.

**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

#### **UNIT - V**

**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc).

**Transmission of Motion and Power:** Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

**Engineering Materials:** Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer.

#### **TEXT BOOKS:**

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson
2. Introduction to Engineering Materials / B.K. Agrawal/ Mc Graw Hill

#### **REFERENCE BOOKS:**

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria

**B.TECH. MECHANICAL ENGINEERING**  
**WORLD CLASS MANUFACTURING**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: ME621OE**

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

**Pre-requisites:** None

**Course Objectives:** To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

**Course Outcomes:** Students should be able to compare the existing industry with WCM companies.

**UNIT - I**

**Information Age and Global Competitiveness:** The Emergence of Information Age; Competition and Business Challenge; Operating Environment; Globalization and International Business; Global Competitiveness and Manufacturing Excellence; World Class Manufacturing and Information Age Competition; Manufacturing Challenges, Problems in Manufacturing Industry.

**UNIT - II**

**Cutting Edge Technology:** Value Added Engineer in - Hall's Framework; Schonberger's Framework of WCM; Gunn's Model; Maskell's Model.

**Philosophy of World Class Manufacturing:** Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management; Culmination of WCM.

**UNIT - III**

**System and Tools for World Class Manufacturing:** The Integration Imperative; Overview of Systems and Tools; Information Management Tools - Product and Process Design Tools, Bar Code Systems, Kanban: A Lean Production Tool, Statistical Quality Control (SQC), Material Processing, and Handling Tools; Assessment of Manufacturing Systems and Tools.

**Labor and HRD Practices in WCM:** Human Resource Dimensions in WCM; Morale and Teamwork; High Employee Involvement; Cross Functional Teams; Work Study Methods; Human Integration Management.

**UNIT - IV**

**Competitive Indian Manufacturing:** Manufacturing Performance and Competitiveness - Indian Firms: Manufacturing Objectives and Strategy; Usage of Management Tools and Technologies; Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure.

**Globalization and World Class Manufacturing:** Generic Manufacturing Strategies for Information Age; Planning Methodology and Issues in Strategic Planning of WCM; Performance Measurement - PO-P System, TOPP System and Ambite System.

**UNIT - V**

**The Future WCM:** Manufacturing Strategy: Futile Search for an Elusive Link, Manufacturing Strategic Intent Classification, Translating Intent into Action.

**Case Studies:** Accelerated Fermentation Process – Using World Class Enzymes; Birla Cellulosic Kharach.

**TEXT BOOKS:**

1. World Class Manufacturing- A Strategic Perspective / BS Sahay, KBS Saxena & Ashish Kumar / Macmillan
2. Making Common Sense Common Practice – Models for Manufacturing Excellence / Ron Moore / Butter Worth Heinemann

**REFERENCE BOOKS:**

1. Managing Technology and Innovation for Competitive Advantage / V. K. Narayanan/ Prentice Hall
2. World Class Manufacturing - The Lesson of Simplicity / Richard J Schonberger / Free Press



**B.TECH. MECHANICAL ENGINEERING**  
**FUNDAMENTALS OF ROBOTICS**  
**(Open Elective – II)**

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

**L T/P/D C**

**Course Code: ME622OE**

**3 0/0/0 3**

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course outcomes:** After this completion of this course, the student should be able to

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications.
- Design intelligent robots using sensors.

**UNIT - I**

Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system & chain type: Serial manipulator & Parallel Manipulator. Components of Industrial robotics-precision of movement-resolution, accuracy & repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors,& Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force or Torque sensors.

**UNIT - II**

Grippers - Mechanical Gripper-Grasping force-Engelberger-g-factors-mechanisms for actuation, Magnetic gripper , vaccume cup gripper-considerations in gripper selection & design . Industrial robots specifications. Selection based on the Application .

**UNIT - III**

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots

#### **UNIT - IV**

Trajectory planning: Joint space scheme- Cubic polynomial fit-Obstacle avoidance in operation space-cubic polynomial fit with via point, blending scheme. Introduction Cartesian space scheme.

Control- Interaction control, Rigid Body mechanics, Control architecture- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

#### **UNIT - V**

Programming of Robots and Vision System-Lead through programming methods- Teach pendent- overview of various textual programming languages like VAL etc.

Machine (robot) vision:

#### **TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

#### **REFERENCE BOOKS:**

1. Theory of Applied Robotics /Jazar/Springer.
2. Robotics / Ghosal / Oxford

**B.TECH. MECHANICAL ENGINEERING**  
**FABRICATION PROCESSES**  
**(Open Elective –II)**

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

**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**

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.

Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – IV**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T.V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING**  
**TOTAL QUALITY MANAGEMENT**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: ME831OE**

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

**UNIT - I**

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

**UNIT -II**

**Customer Focus and Satisfaction:** Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

**Bench Marking:** Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

**UNIT- III**

**Organizing for TQM:** The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, Ishikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

**UNIT- IV**

**The Cost of Quality:** Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

**UNIT -V**

**ISO9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

**TEXT BOOK:**

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

**REFERENCE BOOKS:**

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

**B.TECH. MECHANICAL ENGINEERING**  
**INDUSTRIAL SAFETY, HEALTH, AND ENVIRONMENTAL ENGINEERING**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: ME832OE**

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

**Pre-requisites:** None

**Course Objectives:**

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1948 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

**Course Outcomes:**

- To list out important legislations related to Health , Safety and Environment
- To list out requirements mentioned in factories act for the prevention of accidents. To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

**UNIT - I**

**Factories Act – 1948 :** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Telangana Factories Rules 1950 under Safety and health chapters of Factories Act 1948

**UNIT II**

**Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

### **UNIT - III**

#### **Manufacture, Storage and Import of Hazardous**

**Chemical Rules 1989** : Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

### **UNIT - IV**

**Other Acts and Rules** : Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act

### **UNIT - V**

**International Acts and Standards:** Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Helath and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

### **TEXT BOOKS:**

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Industrial Safety, Health and Environment Management Systems / R. K. Jain, Sunil S. Rao / Khanna Publishers.

### **REFERENCE BOOKS:**

1. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
4. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
5. The manufacture, storage, and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

**B.TECH. MECHANICAL ENGINEERING**  
**BASICS OF THERMODYNAMICS**  
**(Open Elective - III)**

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

**L T/P/D C**

**Course Code: ME833OE**

**3 0/0/0 3**

**Pre-requisite:** Engineering Chemistry and Physics

**Course Objective:** To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

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

- Understand and differentiate between different thermodynamic systems and processes
- Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes
- Understand and analyze the Thermodynamic cycles

**UNIT – I**

**Introduction: Basic Concepts:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility

**UNIT - II**

Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

**UNIT – III**

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (cp and cv), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

**UNIT - IV**

Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const.



Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Psychrometric chart.

#### **UNIT - V**

**Power Cycles:** Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

**Refrigeration Cycles:** Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

#### **TEXT BOOKS:**

1. Basic Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Engineering Thermodynamics / Chattopadhyay/ Oxford

#### **REFERENCE BOOKS:**

1. Thermodynamics for Engineers / Kenneth A. Kroos , Merle C. Potter/ Cengage
2. Thermodynamics /G.C. Gupta /Pearson

**B.TECH. MECHANICAL ENGINEERING**  
**RELIABILITY ENGINEERING**  
**(Open Elective - III)**

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

**L T/P/D C**

**Course Code: ME834OE/AM852PE/EI862PE**

**3 0/0/0 3**

**Prerequisite:** Mathematics III

**Course Objectives:**

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

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

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

**UNIT – I**

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

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

**UNIT – II**

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

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

**UNIT – III**

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

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

**UNIT – IV**

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

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

**UNIT – V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOK:**

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

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
FABRICATION PROCESSES  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: NT511OE**

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

**Course Objectives:** Understand the philosophies of various Manufacturing process.

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

**UNIT – I**

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings; Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth. Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – IV**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T. V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
NON DESTRUCTIVE TESTING METHODS  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: NT512OE**

**L T P C**  
**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 steel and ferrous metals. The objectives aim to:

1. Identify the basic methods of testing.
2. Understand the concept of non destructive testing.
3. Describe the various types of NDT tests carried out on components.
4. Describe ultrasonic method of testing the materials.
5. Analyze the different types of test carried out on components and surfaces.
6. Understand the properties of materials suitable for NDT test.
7. Understand the radiography uses in engineering.

**Course Outcomes:** At the end of the course the students are able to:

1. Identify the requirements of testing criteria as per material composition.
2. Understand the theory of non destructive testing methods is used.
3. Determine the type of requirement of non destructive test.
4. Distinguish between the various NDT test as Ultrasonic and Eddy current methods.
5. Understand the properties of radiation used in engineering.
6. Describe the various types of non destructive test used to determine the surface cracks.

**UNIT - I**

**Overview of NDT - NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.**

**UNIT - II**

**Surface NDE Methods:** Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

### **UNIT - III**

**Thermography and Eddy Current Testing** - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

### **UNIT - IV**

**Ultrasonic Testing and Acoustic Emission** - Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications

### **UNIT - V**

**Radiography** - Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

### **TEXT BOOKS:**

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing; Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques; 1st revised edition, New Age International Publishers, 2010

### **REFERENCES:**

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, Handbook of Non-destructive evaluation", McGraw Hill, New York 2001.

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

**B.Tech. III Year I Sem.**  
**Course Code: NT513OE**

L	T	P	C
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 steel and ferrous metals. The objectives aim to:

- Identify the basic crystalline structure of steel.
- Understand the concept of TTT.
- Describe the various heat treatment methods to obtain the desired properties.
- Describe the composition of carbon contents in steel.
- Analyze the different forms of iron obtained during heating of steel.
- Understand the properties of non-ferrous alloys.
- Understand requirement.

**Course Outcomes:** At the end of the course the students are able to:

- This subject gives student a technical knowledge about behavior of metals.
- Identify the crystalline structure of steel.
- Understand the theory of time temperature and transformation.
- Determination of different uses of heat treatment in steel.
- Distinguish between the various forms of steel.
- Understand the properties of non-ferrous alloys.
- Describe the various uses of composite materials.

**UNIT – I**

**Structure of Metals:** Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

**UNIT –II**

**Phase Diagrams:** Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.



**UNIT – III**

**Steels:** Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe<sub>3</sub>C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

**UNIT – IV**

**Cast Irons:** Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

**UNIT – V**

**Ceramics, Polymers and Composites:** Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

**TEXT BOOKS:**

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R. Askeland / Thomson.

**REFERENCE BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and engineering / William and Callister.
3. Elements of Material science / V. Rahghavan

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
INTRODUCTION TO MATERIALS HANDLING  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: NT621OE**

**L T P C**  
**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:**

1. Materials Handling Equipment – N. Rudenko , Envee Publishers, New Delhi
2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow

### **REFERENCE BOOKS:**

1. Aspects of Material handling - Arora
2. Introduction to Material Handling- Ray
3. Plant Layout and Material Handling- Chowdary RB

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
NON-CONVENTIONAL ENERGY SOURCES  
(Open Elective – II)**

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

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

**Course Overview:**

Non Conventional resources include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Non Conventional energy technologies produce power, heat or mechanical energy by converting those resources either to electricity or to motive power. The policy maker concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications. Such commercial technologies include hydroelectric power, solar energy, fuels derived from biomass, wind energy and geothermal energy. Wave, ocean current, ocean thermal and other technologies that are in the research or early commercial stage, as well as non-electric Non Conventional energy technologies, such as solar water heaters and geothermal heat pumps, are also based on Non Conventional resources, but outside the scope of this Manual.

**Course Objectives:**

- Graduates will demonstrate the ability to use basic knowledge in mathematics, science and engineering and apply them to solve problems specific to mechanical engineering (Fundamental engineering analysis skills).
- Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results (Information retrieval skills).
- Graduates should be capable of self-education and clearly understand the value of life-long learning (Continuing education awareness).
- Graduates will develop an open mind and have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues (Social awareness).
- Graduate will be able to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete project (Practical engineering analysis skills).

**Course Outcomes:**

- Introduction to Renewable Energy Sources, Principles of Solar Radiation, Different Methods of Solar Energy Storage and its Applications, Concepts of Solar Ponds, Solar Distillation and Photo Voltaic Energy Conversion

- Introduction to Flat Plate and Concentrating Collectors ,Classification of Concentrating Collectors
- Introduction to Wind Energy, Horizontal and Vertical Access Wind Mills, Bio-Conversion
- Types of Bio-Gas Digesters and Utilization for Cooking Geothermal Energy Resources
- Types of Wells and Methods of Harnessing the Energy, Ocean Energy and Setting of OTEC Plants
- Tidal and Wave Energy and Mini Hydel Power Plant, Need and Principles of Direct Energy Conversion
- Concepts of Thermo-Electric Generators and MHD Generators

#### **UNIT - I**

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

#### **UNIT - II**

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

#### **UNIT - II**

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion - Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors- Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

#### **UNIT - IV**

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features- Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

#### **UNIT - V**

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small

cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

**TEXT BOOKS:**

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.

**REFERENCE BOOKS:**

1. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
2. Wakil MM, *Power Plant Technology*, Mc Graw Hill Book Co, New Delhi, 2004.
3. Non - Conventional Energy Sources. Rai

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
ROBOTICS  
(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: NT623OE**

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

**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

#### **UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

**Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

#### **UNIT – II**

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

### **UNIT – III**

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

### **UNIT IV**

#### **Robot actuators and Feedback components:**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

### **UNIT V**

#### **Robot Application in Manufacturing:**

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

#### **TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

#### **REFERENCE BOOKS:**

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science



**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
CONCEPTS OF NANO SCIENCE AND TECHNOLOGY  
(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: NT831OE**

**L T P C**  
**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**

**Tools for Nanoscience and Technology:** Tools for measuring properties of Nanostructures, Tools to Make Nanostructures. Nano scale Bio-structures, modelling

**UNIT - IV**

**Nano-Biotechnology:** Bio-molecules; Biosensors; Nanomaterials in drug delivery; Working in clean room environments; Safety and related aspects of Nanomaterials;

**UNIT – V**

**Carbon Nanomaterials and Applications:** Carbon Nano structures and types of Carbon Nano tubes, growth mechanisms of carbon nanotubes. Carbon clusters and Fullerenes, Lithium & Hydrogen adsorption & storages, Fuel cell applications and energy storage, Chemical Sensors applications of CNTs

**TEXT BOOKS AND REFERENCES:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanotechnology Fundamentals and Applications- by Manasi Karkare I. K International
4. Nanoscience and Nanotechnology in engineering – by Vijay K Varadan A Sivathanu pillai Word scientific
5. Nanotechnology Applications To Telecommunications And Networking By Daniel Minoli, Wiley Interscience
6. Nanotechnology Principles and Applications by Sulabha Kulkarni

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
SYNTHESIS OF NANOMATERIALS  
(Open Elective - III)**

**B.Tech. IV Year II Sem.**  
**Course Code: NT832OE**

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

**Course Objectives:**

- To provide knowledge about top-down and bottom-up approaches for the synthesis of nanomaterials.
- To enhance the various nanosynthesis techniques and to identify and solve problems
- To design and conduct experiments relevant to nanochemistry, as well as to analyze the results.
- To improve usage of synthesis methods for modern technology

**Course Outcome:** To provide abundant knowledge on various synthesis methods of nanomaterials.

**UNIT - I**

Introduction, Bottom-up approach: Sol-gel method, emulsion and Top-down: ball milling approach with examples.

**UNIT - II**

Physical methods: Inert gas condensation, Arc discharge, plasma synthesis, electric explosion of wires, molecular beam epitaxy, Physical Vapour Deposition, thermal evaporation, lithography and sputtering.

**UNIT - III**

Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, co-precipitation method. Semiconductor nanocrystals by arrested precipitation, sonochemical routes

**UNIT - IV**

Biological methods – use of bacteria, fungi, actinomycetes for nano-particle synthesis nano-particles Solvated metal atom dispersion, Template based synthesis of nanomaterials.

**UNIT - V**

Thermolysis route - spray pyrolysis, solvothermal and hydrothermal routes, solution combustion synthesis, Chemical vapor deposition

**TEXTBOOKS:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B .Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanostructures and Nanomaterials by Guozhong Cao
4. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
6. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
7. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J.Murray

**REFERENCE BOOKS:**

1. Encyclopedia of Nanotechnology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Science and Nanotechnology – by T. Pradeep, Tata McGraw Hill

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND  
NANOTECHNOLOGY)  
CHARACTERIZATION OF NANOMATERIALS  
(Open Elective - III)**

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

**Course Objectives:**

- To develop ability to understand modern characterization techniques especially utilized to probe in nanoscopic regime
- To elucidate on application of standard spectroscopy, microscopy techniques for element analysis, structure analysis, depth profiling, topography imaging, as well as surface and interface analysis
- To provide overview of principles underlying the characterization methods and basic theory for analysis of the data obtained from the instrument
- The objective of this course is to make the students understand the principles underlying various spectroscopies and instrumentations specific to nanomaterials

**UNIT - I**

**Fundamentals of Electron Microscopy:** Advantages of Electron Microscope over Optical Microscope (Magnification, Resolution, Depth of field). Theory and principle of Electron Microscope, Electron sources, Electron lenses (Electrostatic and Electromagnetic).

**UNIT - II**

**Scanning Electron Microscopy: SEM:** Theory of operation, Specimen-Beam interactions Importance of beam spot size, Machine variables, Scanning Electron Microscope (SEM). **Specimen Preparation in SEM:** Special methods for various sample types – Biological sample preparation, Applications of SEM

**UNIT - III**

**Transmission Electron Microscopy: TEM:** Theory of operation, Modes of operation, Transmission Electron Microscope (TEM), Bright field Imaging, Electron diffraction, Dark field imaging, High Resolution TEM (HRTEM), Applications of TEM.

**UNIT - IV**

**Atomic Force Microscopy: AFM:** Basic concepts – Interactive forces, Principle and instrumentation, Force curves and force measurements, Modes of imaging: Tapping, contact and non-contact, Probes, Tip functionalization,

**UNIT - V**

**X-Ray Diffraction and Spectroscopic methods:**

X-ray diffraction–Powder method, Single crystal diffraction technique -Determination of crystal structures – Nanostructural analysis – Profile analysis (peak broadening and micro strain) – Crystallite size analysis using Scherer formula and Williamson – Hall equation. UV Spectroscopy, IR Spectroscopy and Raman Spectroscopy

**TEXT BOOKS:**

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni – Capital Publishing Company
2. Nano: The Essentials – Understanding Nanoscience and Nanotechnology by T. Pradeep. Tata McGraw Hill
3. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens, Wiley India Pvt Ltd.
4. A practical approach to X-Ray diffraction analysis by C. Suryanarayana

**REFERENCES:**

1. Haynes. R, Woodruff. D. P. and Talchar, T.A., optical Microscopy of Materials Cambridge University press, 1986.
2. Flegler, S.L., Heckman, J.W. and Klomparens, K.L., scanning and Transmission Electron Microscopy: A Introduction WH Freeman & Co, 1993.
3. Paul E. West, introduction to Atomic Force Microscopy Theory Practice Applications
4. Julian Chen N, C., introduction to Scanning Tunneling Microscopy, Oxford University Press, Inc., 1993.
5. Magonov, S.M., and Whangbo, M-H., surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis VCH Publishers, Inc., New York 1996.
6. Goldstein, J., Newbury, D.E., Joy, D.C., and Lym, C.E., scanning Electron Microscopy and X-ray Microanalysis, 2003.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**ANALOG AND DIGITAL IC APPLICATIONS**  
**(OPEN ELECTIVE – I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT5110E**

**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.

**D-A and A- D Converters :** Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC specifications.

**UNIT - IV**

Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Design using TTL-74XX & CMOS 40XX series, code converters, decoders, Demultiplexers, decoders, & drives for LED & LCD display. Encoder, priority Encoder, multiplexers, & their applications, priority generators/checker circuits. Digital arithmetic circuits-parallel binary adder/subtractor circuits using 2's, Complement system. Digital comparator circuits.

## **UNIT - V**

**Sequential Circuits:** Flip-flops & their conversions. Design of synchronous counters. Decade counter, shift registers, & applications, familiarities with commonly available 74XX & CMOS 40XX series of IC counters.

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

### **TEXT BOOKS:**

1. Linear Integrated Circuits –D. Roy Choudhury, New Age International (p) Ltd, 2nd Ed., 2003.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

### **REFERENCES:**

1. Operational Amplifiers & Linear Integrated Circuits – R.F. Coughlin & Fredrick F. Driscoll, PHI, 1977.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco, McGraw Hill, 3rd Ed., 2002.
4. Digital Fundamentals – Floyd and Jain, Pearson Education, 8th Edition, 2005.



**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**INTELLECTUAL PROPERTY RIGHTS**  
**(Open Elective – I)**

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

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

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

**UNIT – IV**

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

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

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

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

**TEXT BOOKS & REFERENCES:**

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

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**COMPUTER ORGANIZATION**  
**(Open Elective – I)**

**B.Tech. III Year I Sem.**  
**Course Code: MT513OE**

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

**Course Objectives:**

- To understand basic components of computers.
- To understand the architecture of 8086 processor.
- To understand the instruction sets, instruction formats and various addressing modes of 8086.
- To understand the representation of data at the machine level and how computations are performed at machine level.
- To understand the memory organization and I/O organization.
- To understand the parallelism both in terms of single and multiple processors.

**Course Outcomes:**

- Able to understand the basic components and the design of CPU, ALU and Control Unit.
- Ability to understand memory hierarchy and its impact on computer cost/performance.
- Ability to understand the advantage of instruction level parallelism and pipelining for high performance Processor design.
- Ability to understand the instruction set, instruction formats and addressing modes of 8086.
- Ability to write assembly language programs to solve problems.

**UNIT - I**

**Digital Computers:** Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

**Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description.

**Micro Programmed Control:** Control memory, Address sequencing, micro program example, design of control unit.

**UNIT - II**

**Central Processing Unit:** The 8086 Processor Architecture, Register organization, Physical memory organization, General Bus Operation, I/O Addressing Capability, Special Processor Activities, Minimum and Maximum mode system and timings.

8086 Instruction Set and Assembler Directives-Machine language instruction formats, Addressing modes, Instruction set of 8086, Assembler directives and operators.

### **UNIT - III**

Assembly Language Programming with 8086- Machine level programs, Machine coding the programs, Programming with an assembler, Assembly Language example programs.

Stack structure of 8086, Interrupts and Interrupt service routines, Interrupt cycle of 8086, Interrupt programming, Passing parameters to procedures, Macros, Timings and Delays.

### **UNIT - IV**

**Computer Arithmetic:** Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating - point Arithmetic operations.

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input –Output Processor (IOP), Intel 8089 IOP.

### **UNIT - V**

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

**Multi Processors:** Characteristics of Multiprocessors, Interconnection Structures, Inter processor arbitration, Inter processor communication, and synchronization.

### **TEXT BOOKS:**

1. Computer System Architecture, M. Moris Mano, Third Edition, Pearson. (**UNITS- I , IV , V**)
2. Advanced Microprocessors and Peripherals, K M Bhurchandi, A.K Ray ,3<sup>rd</sup> edition, McGraw Hill India Education Private Ltd. (**UNITS - II, III**).

### **REFERENCES:**

1. Microprocessors and Interfacing, D V Hall, SSSP Rao, 3<sup>rd</sup> edition, McGraw Hill India Education Private Ltd.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5<sup>th</sup> Edition, Tata McGraw Hill, 2002
3. Computer Organization and Architecture, William Stallings, 9th Edition, Pearson.
4. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4<sup>th</sup> Edition, Elsevier, 2009.

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

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

**L T P C**

**Course Code: EM614PE/MT621OE**

**3 0 0 3**

**Course Objectives:**

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

**Course Outcomes:**

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

**UNIT - I**

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

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

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

**UNIT - II**

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

**UNIT - III**

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

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

**UNIT - IV**

Searching - Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

**UNIT - V**

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees. Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

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

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

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

**Course Objectives:**

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

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

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

**UNIT - I**

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

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

**UNIT - II**

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

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**INDUSTRIAL MANAGEMENT**  
**(Open Elective – II)**

**B.Tech. III Year II Sem.**  
**Course Code: MT623OE**

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

**UNIT - I**

**Introduction to Management:** Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

**UNIT - II**

**Designing Organizational Structures:** Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

**UNIT - III**

**Operations Management:** Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production),-Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)

Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

**UNIT - IV**

**Work Study:** Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

**Statistical Quality Control:** variables-attributes, Shewart control charts for variables-  $\bar{X}$  chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

**UNIT - V**

**Job Evaluation:** methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

**Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path,



Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

**TEXT BOOKS:**

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers
2. Industrial Engineering and Management Science/T.R. Banga and S. C. Sarma/Khanna Publishers

**REFERENCE BOOKS:**

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons Work Study by ILO
2. Human factors in Engineering & Design/Ernest J McCormick / TMH
3. Production & Operation Management /Paneer Selvam /PHI
4. Industrial Engineering Management/NVS Raju/Cengage Learning
5. Industrial Engineering Hand Book /Maynard
6. Industrial Engineering Management / Ravi Shankar/ Galgotia

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**  
**RENEWABLE ENERGY SOURCES**  
**(Open Elective – III)**

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

**L T P C**

**Course Code: MT831OE/ME853PE**

**3 0 0 3**

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO<sub>2</sub> reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### **UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

#### **UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection.

#### **REFERENCE BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

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

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

**L T P C**

**Course Code: MT832OE/ME854PE**

**3 0 0 3**

**Pre-requisites:** Management Science & Productivity.

**Course Objectives:** Understand the importance of Production planning & control. Learning way of carrying out various functions it so as to produce right product, right quantity at right time with minimum cost.

**Course Outcomes:** At the end of the course, the student will be able to, Understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

**UNIT – I**

**Introduction:** Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

**Forecasting** – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

**UNIT – II**

**Inventory management** – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning** – Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

**UNIT – III**

**Line Balancing:** Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

**UNIT – IV**

**Scheduling** –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling – job shop scheduling, line of balance (LOB) – objectives - steps involved.

**UNIT – V**

**Dispatching:** Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**Follow up:** definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

**TEXT BOOKS:**

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

**REFERENCE BOOKS:**

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

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

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

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

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

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

**Unit – 1: Entrepreneurial Perspectives:**

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

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

**Unit – 2: New Venture Creation:**

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

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

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

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING**  
**MATERIAL CHARACTERIZATION TECHNIQUES**  
**(OPEN ELECTIVE –I)**

**B.Tech. III Year I Sem.**  
**Course Code: MM5110E**

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

**Course Objective:** This course is intended to give an exposure to evaluation of special characteristics of materials (Structural, Mechanical & Thermal etc.) in order to understand their suitability in Engineering Applications

**Course Outcome:** At the end of the course the student will be able to characterize, identify, and apply the material to the concerned application.

**UNIT-I**

**X-Ray Diffraction:** Introduction, Production and properties of x-rays, Bragg's law of diffraction. Experimental Methods of Diffraction, Intensity of Diffracted beams - Scattering by an electron by an atom, by a unit cell, structure-factor calculations; factors affecting Diffraction Intensities.

**Application of XRD:** Orientation of single crystals, Effect of plastic deformation, the structure of polycrystalline Aggregates, Determination of crystal structure, Precise lattice parameter measurements, Phase - diagram determination, Order-disorder transformation, Chemical analysis by Diffraction, Stress measurement

**UNIT-II**

**Elements of Quantitative Metallography and Image Processing.**

**Scanning Electron Microscopy:** Principle, Interaction of electron beams with matter, Construction and Working principle Scanning Electron Microscopy, Working Distance, Depth of field, Depth of focus and Spot Size, Specimen preparation for Scanning Electron Microscopy, Different types of modes used in Scanning Electron Microscopy (Secondary Electron and Backscatter Electron) and their applications, Advantages, limitations and applications of Scanning Electron Microscopy, Electron Backscattered Diffraction.

**UNIT-III**

**Transmission Electron Microscopy:** Principle, Construction and Working principle of Transmission Electron Microscopy, Resolving power and Magnification, Depth of field and Depth of focus, Bright and dark field, Specimen preparation for the Transmission Electron Microscopy: Selected Area Diffraction, Applications of Transmission Electron Microscopy, Advantage and Limitations of Transmission Electron Microscopy.



**UNIT-IV**

**Spectroscopy – Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy, Electron Probe Microanalyzer,**

**UNIT-V**

Principles, Instrumentation, operation and application of thermal analysis, Thermogravimetric Analysis, TGA, Differential Scanning Calorimetry, Differential thermal analysis, Dynamic Mechanical Analysis, Dilatometry.

**TEXT BOOKS:**

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

**REFERENCES:**

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall , 2001 – Science

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

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

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

**Course Objective:** This course is intended to expose the students to the most exciting area of nano materials. This would emphasize the classification, synthesis and applications of these materials.

**Course Outcome:** The student will be able to design a component/material that would provide us a 'better tomorrow' via nanotechnology.

**UNIT-I**

Introduction: History and Scopy, classification of nanostructural materials, Applications, Challenges and future prospects

**UNIT-II**

Unique properties of nano-materials, microstrucutre and defects in nano-crystalline materials, effect of nano-dimension on material behaviours

**UNIT-III**

Synthesis Routes: Bottom up approaches, top down approaches, consolidation of nano-powders.

**UNIT-IV**

Application of nano-materials: Nano-electronics, Micro and Nano-electromechanical systems, nano-sensors, Nano-catalyst, Structure and engineering, Automotive, Nano-medical, water and environment treatment, energy, defence and space, textile and paints.

**UNIT-V**

Nanostructured materials with high application potential: Quantum dots, Carbon nanotubes, GaN Nanowires, Nanocrystalline Zno, Nanocrystalline Tio<sub>2</sub>, Multilayered films

**TEXT BOOKS:**

1. Text book of Nano Science and Technology: B S Murthy, Universities press-IIM series in Metallurgy and Material Sciene
2. Nano Essentials: T Pradeep / TMH

**REFERENCES:**

1. Springer Handbook of Nanotechnology
2. Nano Materials Synthersis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandyopadyay/ New age Publications

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING  
METALLURGY FOR NON METALLURGISTS  
(OPEN ELECTIVE - II)**

**B.Tech. III Year II Sem.**  
**Course Code: MM622OE**

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

**Course Objectives:**

- To describe the basic principles of metallurgy and the importance of metallurgy in various discipline of engineering.
- Gain a thorough knowledge about heat treatment of steels.
- Gain knowledge about properties and uses of cast irons and non ferrous metals.
- Gain a working knowledge of basic testing methods for metals.

**Course Outcomes:** At the end of the course Student would be able

- To use and apply metallurgy in his own branch of engineering.
- The student will be able to justify the various testing methods adopted for metals.

**UNIT-I**

**Introduction:** Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels

**UNIT-II**

**Heat Treatment of Steels:** The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering

**UNIT-III**

**Cast irons:** Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

**UNIT-IV**

**Non Ferrous Metals:** Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys

**UNIT-V**

**Testing of Metals:** Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

**TEXT BOOKS:**

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997
3. Mechanical Metallurgy – G. E. Dieter

**REFERENCES:**

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006
3. Foundations of Materials Science and Engineering – WF Smith

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING  
DESIGN AND SELECTION OF ENGINEERING MATERIALS  
(OPEN ELECTIVE - III)**

<b>B.Tech. IV Year II Sem.</b>	<b>L T P C</b>
<b>Course Code: MM831OE</b>	<b>3 0 0 3</b>

**Course Objective:** This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

**Course Outcome:** Understand the Relationship between materials selection, processing and applications.

#### **UNIT-I**

**Materials selection process:** Criteria for selection of materials

#### **UNIT-II**

**Effect of composition, processing and structure on materials properties:** Concepts in the design of industrial components

#### **UNIT-III**

**Properties vs Performance materials:** Aerospace and defense applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, Intermetallics, Aluminides

#### **UNIT-IV**

**Nuclear Material: Manufacturing aspects of design**

Nuclear application: radiation damage, effect of radiation damage on YS, UTS, DBTT, design of alloy for fission and fusion reactors

#### **UNIT-V**

**Special Materials: Manufacturing aspects of design**

Selection and design of ceramics composites and polymers for specific applications,

#### **TEXT BOOKS**

1. M.F. Ashby, *Materials Selection in Mechanical Design*, Pergamon Press, 1992
2. G.E. Dieter, *Engineering Design, A Materials and Processing Approach*, 2nd ed., McGraw-Hill, 1991

#### **REFERENCES**

1. T.H. Courtney, *Mechanical Behavior of Materials*, McGraw-Hill, 1990
2. J.R. Dixon and C. Poli, *Engineering Design and Design for Manufacturing*, Field Stone Publishers, 1995

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

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

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

**Course Objectives:** The student is expected to learn the fundamentals of mining engineering so as to encourage multi-disciplinary research and application of other branches of engineering to mining technology.

**Course Outcomes:** Upon completion of the course, the student shall be able to understand various stages in the life of the mine, drilling, blasting and shaft sinking.

**UNIT-I**

Introduction: Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology,

**UNIT-II**

Stages in the life of the mine - prospecting, exploration, development, exploitation, and reclamation. Access to mineral deposit- selection, location, size and shape (incline, shaft and adit), brief overview of underground and surface mining methods.

**UNIT-III**

Drilling: Types of drills, drilling methods, electric, pneumatic and hydraulic drills, drill steels and bits, drilling rigs, and jumbos.

**UNIT-IV**

Explosives: Classification, composition, properties and tests, fuses, detonators, blasting devices and accessories, substitutes for explosives, handling and storage, transportation of explosives.; Rock blasting: Mechanism of rock blasting, blasting procedure, and pattern of shot holes.

**UNIT-V**

Shaft sinking: Ordinary and special methods, problems, and precautions, shaft supports and lining.

**TEXT BOOKS:**

1. R. P. Pal, Rock blasting effect and operation, A. A. Balkema, 1<sup>st</sup> Ed, 2005.
2. D. J. Deshmukh, Elements of mining technology, Vol. 1, Central techno, 7<sup>th</sup> Ed, 2001

**REFERENCE BOOKS:**

1. C. P. Chugh, Drilling technology handbook, Oxford and IBH, 1<sup>st</sup> Ed, 1977.
2. R. D. Singh, Principles and practices of modern coal mining, New age international, 1<sup>st</sup> Ed, 1997.

**B.TECH. MINING ENGINEERING**  
**COAL GASIFICATION, COAL BED METHANE AND SHALE GAS**  
**(Open Elective - II)**

**B.Tech. III Year II Sem**  
**Course Code: MN621OE**

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

**Course Objectives:** To specialize the students with additional knowledge on geological and technological factors of coal gasification industry mining methods of underground coal gasification, linkage techniques etc.

**Course Outcomes;** Student can get specialized in the underground coal gasification concepts, application and future scope in various geomining conditions.

**UNIT-I**

Underground Coal Gasification (UCG) Concept; Chemistry, conditions suitable for UCG, Principles of UCG., Merits and Demerits.

**UNIT-II**

UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG.

**UNIT-III**

Mining methods of UCG: Chamber method, Stream method, Borehole procedure method, Blind bore hole method.

**UNIT-IV**

Non-Mining methods of UCG: Level seams, Inclined seams.

**UNIT-V**

Linkage Techniques: Pekcolation linkage, Electro linkage, Boring linkage, compressed-air-linkage, Hydraulic fracture linkage. Future Scope and Development: Innovations.

**TEXT BOOKS:**

1. Underground Coal Mining Methods – J.G. SINGH
2. Winning and Working Coal in India Vol.II- R. T. Deshmukh and D.J.Deshmukh.

**REFERENCE BOOK:**

1. Principles and Practices of Modern Coal Mining – R.D. SINGH

**B.TECH. MINING ENGINEERING**  
**SOLID FUEL TECHNOLOGY**  
**(Open Elective - III)**

**B.Tech. IV Year II Sem**  
**Course Code: MN831OE**

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

**Pre-requisites:** Under graduate Physics and Chemistry

**Course Objectives:** Understand coal formation, properties, and their evaluation along with various issues of coal washing

**Course Outcomes:** Students can understand the fundamentals of Processes of formation of coal, properties and evaluation and coal preparation and washability characteristics of coal

**UNIT-I**

Introduction: Processes of formation of coal, Theories of origin of coal, Eras of coal formation, Indian Coalfields and its subsidiaries: Occurrence and distribution, coal bearing formations, coal type and rank variation, Characteristics of major coalfields, Coal production from different sectors.

**UNIT-II**

Coal petrography: Macro and micro lithotypes, Composition of macerals, application of coal petrography, Mineral matter in coal: Origin and chemical composition, Impact of mineral matter in coal process industry.

**UNIT-III**

Coal properties and their evaluation: proximate and ultimate analysis, calorific value, crossing and ignition point temperature, plastic properties (free swelling index, Caking index, Gray King Low Temperature Assay, Roga index, plastometry, dilatometry).

**UNIT-IV**

Physical properties like specific gravity, hard groove grindability index, heat of wetting, crossing point temperature of coal, Behavior of coal at elevated temperatures and products of thermal decomposition, Classification of coal - International and Indian classification, grading of Indian coals.

**UNIT-V**

Coal Washing: Principles, objectives, coal preparation, washability characteristics; Selection, testing, storage and utilization of coking and non-coking coal, Use of coal by different industries.



**TEXT BOOKS:**

1. S. Sarkar, Fuels and Combustion, Orient Longman Private Ltd., 2<sup>nd</sup> edition, 1990
2. O. P. Gupta, Elements of Fuels, Furnaces and Refractories, Khanna Publication, 3<sup>rd</sup> Edition, 1996.

**REFERENCE BOOKS:**

1. M. A. Elliot, Chemistry of Coal Utilization, Wiley, 1981.
2. D. Chandra, R. M. Singh, and M. P. Singh, Text Book of Coal, Tara Book Agency, 2000.

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

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

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

**Course Objectives:** To brief mining students in health and safety engineering concepts, causes of accident, training, human behavioral approach in safety etc.

**Course Outcomes:** student will gain knowledge and able to understand the importance of health and safety including the role of safety risk assessment in mining industry

**UNIT-I**

Introduction to accidents, prevention, health and safety in industry : Terminology, reason for preventing accidents – moral and legal.

Safety scenario in Indian mines, Accidents in Indian mines, Measurement of safety performance. Classification of accidents as per Mining legislation/law and general classification of accidents.

**UNIT-II**

Causes and preventive measures of accidents in underground and opencast mines i.e., due to fall of roof and sides, transportation of machinery, haulage and winding, drilling and blasting, movement of machinery in opencast mines and electricity etc., ; accident analysis and report, cost of accidents, statistical analysis of accidents and their importance for promotion of safety.

**UNIT-III**

System engineering approach to safety, techniques used in safety analysis, generic approach to loss control within mining operations. Concept of ZAP and MAP.

**UNIT-IV**

Risk management, Risk identification, Risk estimation and evaluation, Risk minimization techniques in mines. Risk analysis using FTA, HAZOP, ETA etc; health risk assessment and occupational diseases in mining.

**UNIT-V**

Development of safety consciousness, publicity and propaganda for safety; training of workmen, Human Behavioral approach in safety, safety polices and audio-visual aids, safety drives campaigns, safety audit. Safety management and organization; Internal safety organization

**TEXT BOOKS:**

1. Occupational Safety and Health in Industries and Mines by C.P. Singh
2. S.K. Das, Mine Safety and Legislation. Lovely Prakashan, Dhanbad, 2002

**REFERENCE BOOKS:**

1. N.J. Bahr, System Safety Engineering, and Risk Assessment: A Practical Approach, Taylor and Francis, NY, 1997.
2. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad

**B.TECH. PETROLEUM ENGINEERING  
MATERIALS SCIENCE AND ENGINEERING  
(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: PE5110E**

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

**Course Objectives:** This subject is intended to:

- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Import expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- To gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

**Course Outcome:** After the course, the students will be to

- Equipped with knowledge to prepare material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures.

**UNIT - I**

Classification of engineering materials, Levels of Structure, Structure-Property relationships in materials, Crystal Geometry and non-crystalline(amorphous) states. Lattice –Bravais lattices, crystal systems with examples. Lattice co-ordinates, Miller and Miller- Bravais Indices for directions and planes: ionic, covalent and metallic solids; packing factors and packing efficiency, ligancy and coordination number. Structure determination by Brag’s X-ray diffraction method.

**UNIT - II**

Crystal Imperfections-classification-point defects-estimation of point defects-Dislocations-classification(edge and screw)-surface defects -dislocation motion and its relevance to mechanical and chemical properties –stress-strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-elastic and plastic deformation-slip -stress required to move a dislocation. Multiplication of dislocations – dislocation reactions, effect on mechanical behavior of materials. Strain hardening/work hardening –dynamic recovery and recrystallization.

### **UNIT - III**

Fracture and failure of materials: ductile fracture analysis-brittle fracture analysis-fracture toughness-ductile-brittle transition-fatigue fracture-theory, creep and mechanism –methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

### **UNIT - IV**

Solid –liquid and solid-solid Equilibria for metals and alloys. Phase rule-phase diagram for pure metals (single component system),alloys(binary systems)-micro structural changes during cooling-Lever rule and its applications-typical phase diagrams-homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures- non-equilibrium cooling. Binary Systems(phase diagrams) for study: Cu-Ni/Bi-Cd/Pb-Sn/ Fe-C /Al-Cu  
Materials for chemical and petrochemical industrial process equipment- Effect of alloying on mechanical and chemical behavior of materials, applications of heat treatment methods for strengthening of engineering materials.

### **UNIT - V**

Composite structures and their advantages over conventional materials–Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement-applications –Nano materials –synthesis and characterization.  
Stability criteria of materials in chemical/petrochemical industrial environments. Corrosion and Oxidation of materials –basic mechanisms-types of corrosion, Corrosion testing and evaluation Prevailing methods to combat corrosion. Coatings –metallic non-metallic, passivity, cathodic protection.

### **TEXT BOOKS:**

1. Materials Science and Engineering, Raghavan, V., 5<sup>th</sup> Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith, and Javed Hashemi, 4<sup>th</sup> Edition, Tata-McGraw Hill, 2008.

### **REFERENCE BOOKS:**

- 1 Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6<sup>th</sup> Edition, Pearson, 2002.
- 2 Materials Science and Engineering, Balasubramaniam, R., Callister's, Wiley, 2010.
3. Corrosion Engineering, Mars G. Fontana, Tata-McGraw Hill, 2005.

**B.TECH. PETROLEUM ENGINEERING**  
**RENEWABLE ENERGY SOURCES**  
**(Open Elective - I)**

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

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

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO<sub>2</sub> reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### **UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

#### **UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection.

#### **REFERENCE BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

**B.TECH. PETROLEUM ENGINEERING**  
**ENVIRONMENTAL ENGINEERING**  
**(Open Elective - I)**

**B.Tech. III Year I Sem.**  
**Course Code: PE513OE**

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

**Course Objectives:** This subject provides the knowledge of water sources, water treatment, design of distribution system waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

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

- Analyze characteristics of water and wastewater
- Estimate the quantity of drinking water and domestic wastewater generated
- Design components of water supply systems Design sewerage system

**UNIT – I**

Introduction: Waterborne diseases – protected water supply – Population forecasts, design period – types of water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards: sources of water - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

**UNIT – II**

Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants - feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation - comparison of filters – disinfection – theory of chlorination, chlorine demand - other disinfection practices- Miscellaneous treatment methods.

**UNIT – III**

Distribution systems requirement –method and layouts -Design procedures- Hardy Cross and equivalent pipe methods pipe – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house - Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow

**UNIT - IV**

characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials – sewer appurtenances manholes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses – house drainage – components requirements – sanitary fittings-traps – one pipe and two pipe systems of plumbing – ultimate disposal of sewage – sewage farming – dilution.



## **UNIT – V**

Waste water treatment plant – Flow diagram - primary treatment Design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – Biological treatment – trickling filters – standard and high rate – Construction and design of oxidation ponds. Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks working principles and design – soak pits.

### **TEXT BOOKS:**

1. Environmental Engineering by H.S Peavy, D. R. Rowe, G. Tchobanog lous, McGraw Hill Education (India) Pvt Ltd, 2014
2. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.
3. Water Supply & Environmental Engineering by A.K. Chatterjee.
4. Water Supply and sanitary Engineering by G.S. Bindi, Dhanpat Rai & Sons Publishers.

### **REFERENCES:**

1. Water and Waste Water Technology by Steel, Wiley
2. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.
3. Water and Waste Water Engineering by Fair Geyer and Okun, Wiley, 2011
4. Water and Waste Water Technology by Mark J Hammar and Mark J. Hammar Jr.Wiley, 2007.

**B.TECH. PETROLEUM ENGINEERING**  
**ENERGY MANAGEMENT AND CONSERVATION**  
**(Open Elective - II)**

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

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

**Course Objectives:** To acquaint the student with the conventional energy sources and their utilization. To understand the importance of heat recovery and energy conservation methods and energy audit.

**Course Outcomes:** Students would have a good knowledge about conventional energy sources and their audit. Ability to apply the fundamentals of energy conservation and management.

**UNIT-I**

Global & Indian Energy Scenario-Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns , Basics of Energy and its various forms.

**UNIT-II**

Energy Audit: Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. Material and Energy balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams,

**UNIT-III**

Energy Action Planning, Financial Management: Financial analysis techniques- Risk and sensitivity analysis- Financing options, Energy performance contracts and role of ESCOs- Energy Monitoring and Targeting: Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

**UNIT-IV**

Building Envelope – principles of analysis – Envelope performance -Envelope analysis of Existing and new buildings – Building standards for new and Existing constructions. HVAC Systems types – Energy conservation opportunities – cooling equipment – Domestic hot water Estimating HVAC Energy consumption.

**UNIT-V**

Principles of Electric Energy Management, Energy Management control systems – Energy systems maintenance. Energy management in water and waste water treatment – solid waste treatment- air pollution control systems .

Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration – Waste Heat recovery. Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act.

**TEXT BOOKS:**

1. Energy Management by Murfy
2. General Aspects of Energy Management and Audit, National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

**REFERENCE BOOKS:**

1. Energy Management Handbook, W.C. Turner, 5<sup>th</sup> Edition, Marcel Dekker, Inc, New York, 2005.
2. Guide to Energy Management, B. L. Capehart, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.
3. Energy Management by O.P. Collagan

**B.TECH. PETROLEUM ENGINEERING**  
**OPTIMIZATION TECHNIQUES**  
**(Open Elective - II)**

**B.Tech. III Year II Sem.**  
**Course Code: PE622OE**

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

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

**Course Objectives:**

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

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

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

**UNIT – I**

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

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

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

**UNIT – II**

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

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

### UNIT – III

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

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

### UNIT – IV

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

### UNIT – V

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

### TEXT BOOKS:

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

### REFERENCE BOOKS:

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

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

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

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

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

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

**Unit – 1: Entrepreneurial Perspectives:**

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

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

**Unit – 2: New Venture Creation:**

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

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

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

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**B.TECH. PETROLEUM ENGINEERING**  
**DISASTER MANAGEMENT**  
**(Open Elective – III)**

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

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

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

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

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

**UNIT - I**

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

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

**UNIT - II**

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

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

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



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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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

**B.Tech. IV Year II Sem.**  
**Course Code: PE832OE**

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

**Course Objectives:** The students will be able to:

- Gain basic knowledge of LNG and its prospective.
- Learn different liquefaction technologies of LNG.
- Have knowledge on different functional units on receiving terminals
- Analyze transportation of LNG and regasification.
- Understand HSE of LNG industry.

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

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

#### **UNIT-I**

**Introduction:** Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

#### **UNIT-II**

**Liquefaction Technologies:** Propane precooled mixed refrigerant process – Description of Air products C<sub>3</sub>MR LNG process – Liquefaction – LNG flash and storage.

**Cascade process:** Description of ConocoPhillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.

**Other Liquefaction Processes:** Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and subcooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

#### **UNIT-III**

**Supporting Functional Units in LNG Plants:** Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulphur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

#### **UNIT-IV**

**Receiving Terminals:** Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions.

Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C<sub>2</sub><sup>+</sup> components.

**LNG Shipping Industry & Major Equipment in LNG Industry:** LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations

#### **UNIT-V**

**Major equipment in LNG industry:** Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressors. LNG pumps and liquid expanders – Loading Arms and gas turbines.

**Vaporizers:** Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.; LNG tanks.

**Safety, Security and Environmental Issues:** Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

#### **TEXT BOOK:**

1. LNG: Basics of Liquefied Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

([https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook\\_demos/lng/HTML/index.html](https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html).)

#### **REFERENCE BOOKS:**

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.

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

**B.Tech. IV Year II Sem.**  
**Course Code: PE833OE**

**L T/P/D C**  
**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**

**The impact of drilling and production operations:** Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.

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

**Waste treatment methods:** Treatment of water- Treatment of solids- Treatment of air emissions-Waste water disposal: surface disposal.

### **UNIT - III**

**Oil mines regulations:** Introduction>Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous- Remediation of contaminated sites- Site assessment-Remediation process.

### **UNIT- IV**

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

### **UNIT - V**

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist)- Inspection & safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment- Suppression of hydrocarbons fires.

### **TEXT BOOKS:**

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

### **REFERENCE BOOKS:**

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3<sup>rd</sup>Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, McGraw Hill, 2014.