



# **VARDHAMAN COLLEGE OF ENGINEERING**

## **(AUTONOMOUS)**

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Shamshabad - 501 218, Hyderabad, Telangana State, India.  
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## **BACHELOR OF TECHNOLOGY**

## **MECHANICAL ENGINEERING**

### **SYLLABI (III Year and IV Year)**

**B. Tech. - Regular Four Year Degree Program**  
**(For batches admitted from the Academic Year 2013 - 2014)**  
**&**  
**B. Tech. - Lateral Entry Scheme**  
**(For batches admitted from the Academic Year 2014 - 2015)**

# **SYLLABI FOR V SEMESTER**

**UNIT - I**

**INTRODUCTION TO MANAGERIAL ECONOMICS:** Definition, Nature and Scope Managerial Economics, *Demand Analysis:* Demand Determinants, Law of Demand and its exceptions.

**ELASTICITY OF DEMAND:** Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting (survey methods, statistical methods, expert opinion method, test marketing, controlled experiments, judgmental approach to demand forecasting).

**UNIT - II**

**THEORY OF PRODUCTION AND COST ANALYSIS:** Production Function, Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Production function, Laws of Returns, Internal and External Economies of Scale.

**COST ANALYSIS:** Cost concepts, Opportunity cost, fixed vs. variable costs, explicit costs vs. Implicit costs, Out of pocket costs vs. Imputed costs. Break Even Analysis (BEA), termination of Break Even Point (simple problems), Managerial Significance and limitations of BEA.

**UNIT - III**

**INTRODUCTION TO MARKETS AND PRICING STRATEGIES:** *Market structures:* Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition.

**PRICE DETERMINATION AND PRICE STATISTICS:** Price-Output Determination in case of Perfect Competition and Monopoly, Pricing Strategies.

**UNIT - IV**

**BUSINESS AND NEW ECONOMIC ENVIRONMENT:** Characteristic features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, Changing Business Environment in Post-liberalization scenario.

**CAPITAL AND CAPITAL BUDGETING:** Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals, *Methods of Capital Budgeting:* Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems).

**UNIT - V**

**INTRODUCTION TO FINANCIAL ACCOUNTING:** Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

**FINANCIAL ANALYSIS THROUGH RATIOS:** Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt-Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

**TEXT BOOKS:**

1. Aryasri (2005), *Managerial Economics and Financial Analysis*, 2<sup>nd</sup> edition, Tata McGraw Hill, New Delhi, India.
2. Varshney, Maheswari (2003), *Managerial Economics*, Sultan Chand, New Delhi, India.

**REFERENCE BOOKS:**

1. Ambrish Gupta (2004), *Financial Accounting for Management*, Pearson Education, New Delhi, India.
2. Domnick Salvatore (2011), *Managerial Economics in a Global Economy*, 7<sup>th</sup> edition, Oxford University Press, United States of America.
3. Narayanaswamy (2005), *Financial Accounting, A Managerial Perspective*, Prentice Hall of India private Ltd, New Delhi, India.

**UNIT - I**

**PRECESSION:** Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships.

**FRICTION:** Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction and film lubrication.

**UNIT - II**

**CLUTCHES:** Friction clutches, Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

**BRAKES AND DYNAMOMETERS:** Simple block brakes, internal expanding brake, band brake of vehicle. Dynamometers, absorption and transmission types. General description and methods of operations.

**UNIT - III**

**TURNING MOMENT DIAGRAM AND FLY WHEELS:** Turning moment, Inertia Torque connecting rod angular velocity and acceleration, crank effort and torque diagrams, Fluctuation of energy, Fly wheels and their design.

**GOVERNERS:** Watt, Porter and Proell governors. Spring loaded governors – Hartnell and hartung with auxiliary springs. Sensitiveness, isochronisms and hunting.

**UNIT - IV**

**BALANCING:** Balancing of rotating masses Single and multiple, single and different planes.

**BALANCING OF RECIPROCATING MASSES:** Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Locomotive balancing - Hammer blow, Swaying couple, variation of tractive efforts.

**UNIT - V**

**VIBRATION:** Free Vibration of mass attached to vertical spring, oscillation of pendulums, centers of oscillation and suspension, Transverse loads, vibrations of beams with concentrated and distributed loads, Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations.

**TEXT BOOKS:**

1. S. S. Ratan (2012), *Theory of Machines*, 3<sup>rd</sup> edition, Tata McGraw- Hill education (P) Ltd, New Delhi, India.
2. Thomas Bevan (2012), *Theory of machines*, 3<sup>rd</sup> edition, CBS Publishers, New Delhi, India.
3. Jagadish Lal, J. M. Shah (2009), *Theory of Machines*, Metropolitan, New Delhi, India.

**REFERENCE BOOKS:**

1. J. S. Rao, R. V. Dukkipati (2010), *Mechanism and Machine Theory*, New Age Publishers, New Delhi, India.
2. Shiegly (2011), *Theory of Machines*, Tata McGraw hill education (P) Ltd, New Delhi, India.
3. Khurmi, R.S. (2011), *Theory of machines*, S.Chand publishers, New Delhi, India.

**UNIT - I**

**METAL CUTTING:** Elementary treatments of metal cutting theory, Element of cutting process, Geometry of single point tool and angles chip formation and types of chips, built up edge and its effects chip breakers. Mechanics of orthogonal cutting, Merchant's Force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, machinability, Tool materials. Kinematic schemes of machine tools.

**UNIT - II**

**ENGINE LATHE:** Principle of working, specification of lathe, types of lathe, work holders tool holders , Box tools Taper turning thread turning , for Lathes and attachments. Turret and capstan lathes, collet chucks, other work holders, tool holding devices. Principal features of automatic lathes, classification, Single spindle and multi-spindle automatic lathes.

**UNIT - III**

**SHAPING SLOTTING AND PLANNING MACHINES:** Principles of working, Principal parts, specification classification, operations performed. Kinematic scheme of the shaping slotting and planning machines, machining time calculations.

**MILLING MACHINE :** Principles of working , specifications , classifications of milling machines ,Principal features of horizontal, vertical and universal milling machines , machining operations Types geometry of milling cutters , milling cutters ,methods of indexing ,Accessories to milling machines, milling cutters ,methods of indexing.

**UNIT - IV**

**DRILLING AND BORING MACHINES:** Principles of working, specifications, types, operations performed, tool holding devices, twist drill, Boring machines, Fine boring machines, Jig Boring machine. Deep hole drilling machine.

**GRINDING MACHINE:** Fundamentals, Theory of grinding, classification of grinding machine , cylindrical and surface grinding machine ,Tool and cutter grinding machine , special types of grinding machines , Different types of abrasives , bonds specification of a grinding wheel and selection of a grinding wheel.

**UNIT - V**

**LAPPING, HONING AND BROACHING MACHINES:** comparison to grinding, lapping and honing Principles of design of Jigs and fixtures and uses. Classification of Jigs & Fixtures, Principles of location and clamping, Types of clamping & work holding devices. Typical examples of jigs and fixtures.

**TEXT BOOKS:**

1. R. K. Jain (2010), *Production Technology*, 16<sup>th</sup> edition, Khanna publishers, New Delhi, India.
2. G. C. Sen, A. Bhattacharya (2010), *Principles of machine tools*, 3<sup>rd</sup> edition, new central book agency (P) Ltd, New Delhi, India.

**REFERENCE BOOKS:**

1. B. S. Raghu Vamshi (2010), *Workshop Technology, Vol - II*, 9<sup>th</sup> Edition, Dhanpat Rai Publishers, New Delhi, India.
2. H.M.T. (Hindustan Machine Tools) (1980), *Production Technology*, 2<sup>nd</sup> edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.
3. Dr. R. kesavan, B. Vijaya Ramanath (2012), *Manufacturing Technology - II*, 2<sup>nd</sup> edition, Laxmi publications, New Delhi, India.

**UNIT - I**

**BASIC CONCEPTS:** Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance, Regeneration and reheating.

**COMBUSTION:** fuels and combustion, adiabatic flame temperature, stoichiometry, flue gas analysis

**UNIT - II**

**BOILERS :** Classification , Working principles , with sketches including H.P. Boilers , Mountings and Accessories , Working principles, Boiler horse power, equivalent evaporation, efficiency and heat balance , Draught, classification , Height of chimney for given draught and discharge, condition for maximum discharge , artificial draught, induced and forced

**STEAM NOZZLES:** Function of nozzle, applications, types, Flow through nozzles, thermodynamic analysis , assumptions , velocity of nozzle at exit-Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio and criteria to decide nozzle shape.

**UNIT - III**

**STEAM CONDENSERS:** Requirements of steam condensing plant, Classification of condensers, working principle of different types, vacuum efficiency and condenser efficiency, air leakage, sources and its affects, air pump, cooling water requirement.

**STEAM TURBINES:** Classification , Impulse turbine; Mechanical details , Velocity diagram , effect of friction, power developed, axial thrust, blade or diagram efficiency , condition for maximum efficiency. De-Laval Turbine - its features. Methods to reduce rotor speed-Velocity compounding and pressure compounding, Velocity and Pressure variation along the flow, combined velocity diagram for a velocity compounded impulse turbine.

**UNIT - IV**

**REACTION TURBINE:** Mechanical details, principle of operation, thermodynamic analysis of a stage, degree of reaction, velocity diagram, Parson's reaction turbine, condition for maximum efficiency.

**GAS TURBINES :** Simple gas turbine plant , Ideal cycle, essential components, parameters of performance, actual cycle , regeneration, inter cooling and reheating ,Closed and Semi-closed cycles , merits and demerits.

**UNIT - V**

**JET PROPULSION:** Principle of Operation ,Classification of jet propulsive engines , Working Principles with schematic diagrams and representation on T-S diagram , Thrust, Thrust Power and Propulsion Efficiency ,Turbo jet engines Schematic Diagram, Thermodynamic Cycle, Performance Evaluation.

**ROCKETS:** Application, Working Principle, Classification, Propellant Type, Solid and Liquid propellant Rocket Engines.

**TEXT BOOKS**

1. R. K. Rajput (2012), *Thermal Engineering*, 18<sup>th</sup> edition, Lakshmi Publications, New Delhi, India.
2. Cohen, Rogers, Saravana Muttu(2011), *Gas Turbines*, 9<sup>th</sup> edition, Addison Wesley Longman, New Delhi, India.

**REFERENCES BOOKS**

1. V. Ganesan (2011), *Gas Turbines*, 3<sup>rd</sup> edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.
2. R. Yadav (2011), *Thermodynamics and Heat Engines*, 7<sup>th</sup> Edition, Central Book Depot, Allahabad, India.
3. P. Khajuria, S. P. Dubey(2009), *Gas Turbines and Propulsive Systems*, 5<sup>th</sup> edition, Dhanpat rai Publications, New Delhi, India.

**UNIT - I**

**INTRODUCTION:** General considerations in the design of Engineering Materials and their properties , selection ,Manufacturing consideration in design, BIS codes of steels.

**STRESSES IN MACHINE MEMBERS:** Simple stresses, Combined stresses, Torsional and bending stresses, impact stresses, stress strain relation, various theories of failure, factor of safety, Design for strength and rigidity, preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations, Static strength design based on fracture toughness.

**UNIT - II**

**STRENGTH OF MACHINE ELEMENTS :** Stress concentration ,Theoretical stress Concentration factor ,Fatigue stress concentration factor notch sensitivity , Design for fluctuating stresses , Endurance limit , Estimation of Endurance strength , Goodman's line , Soderberg's line , Modified goodman's line.

**UNIT - III**

**RIVETED AND WELDED JOINTS:** Design of joints with initial stresses, eccentric loading

**BOLTED JOINTS:** Design of bolts with pre-stresses, Design of joints under eccentric loading, locking devices, both of uniform strength, different seals.

**UNIT - IV**

**KEYS, COTTERS AND KNUCKLE JOINTS, SHAFTS:** Design of Keys, stresses in keys, cottered joints, spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints.

**SHAFTS:** Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined bending and axial loads , Shaft sizes , BIS code. Use of internal and external circlips, Gaskets and seals (stationary & rotary).

**UNIT - V**

**SHAFT COUPLING:** Rigid couplings, Muff, Split muff and Flange couplings. Flexible couplings, Flange coupling (Modified)

**MECHANICAL SPRINGS:** Stresses and deflections of helical springs, Extension, compression springs, Springs for fatigue loading, natural frequency of helical springs , Energy storage capacity ,helical torsion springs , Co-axial springs, leaf springs.

**TEXT BOOKS:**

1. V. Bandari (2011), *A Text Book of Design of Machine Elements*, 3<sup>rd</sup> edition, Tata McGraw hill education (P) ltd, New Delhi, India.
2. R. L. Norton (2006), *Machine Design (An Integrated approach)*, 2<sup>nd</sup> edition, Pearson Publishers, Chennai, India.

**REFERENCE BOOKS:**

1. Shigley, J.E, (2011), *Mechanical Engineering Design*, 9<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, India.
2. S. M.D. Jalaludin, (2011), *Machine Design*, 3<sup>rd</sup> Edition, Anuradha Publishers, Kumbakonam, Chennai, India.
3. P. Kanniah, (2012), *Machine Design*, 2<sup>nd</sup> Edition, Scitech Publications India Pvt. Ltd, New Delhi, India.

**UNIT - I**

**SYSTEMS OF LIMITS AND FITS:** Introduction, normal size, tolerance limits, deviations, allowance, fits and their types, unilateral and bilateral tolerance system, hole and shaft basis systems, interchangeability and selective assembly. Indian standard Institution system, British standard system.

**UNIT - II**

**LINEAR MEASUREMENT:** Length standard, line and end standard, slip gauges, calibration of the slip gauges, Dial indicator, micrometers.

**MEASUREMENT OF ANGLES AND TAPERS:** Different methods, Bevel protractor, angle slip gauges, spirit levels, sine bar, Sine plate, rollers and spheres used to determine the tapers.

**LIMIT GAUGES:** Taylor's principle, Design of go and No go gauges, plug ring, snap, gap, taper, profile and position gauges.

**UNIT - III**

**OPTICAL MEASURING INSTRUMENTS:** Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

**FLAT SURFACE MEASUREMENT:** Measurement of flat surfaces, instruments used straight edges, surface plates, optical flat and auto collimator.

**SCREW THREAD MEASUREMENT:** Element of measurement, errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

**UNIT - IV**

**SURFACE ROUGHNESS MEASUREMENT:** Differences between surface roughness and surface waviness-Numerical assessment of surface finish, CLA,R, R.M.S Values, Rz values, Rz value, Methods of measurement of surface finish-profilograph. Talysurf, ISI symbols for indication of surface finish.

**MEASUREMENT THROUGH COMPARATORS:** Comparators, Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

**MACHINE TOOL ALIGNMENT TESTS:** Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools. Preparation of acceptance charts.

**UNIT - V**

**COORDINATE MEASURING MACHINES:** Types of CMM, Role of CMM, and Applications of CMM.

**SURFACE ENGINEERING:** Surface texture and properties, Surface cleaning techniques, Surface integrity, Wear and its measurements, Lubricants and its selection for reducing wear, Principle of corrosion and remedial measurements, Laser applications for surface modifications.

**MECHANICAL SURFACE TREATMENT:** Surface treatment processes and their characteristics and applications. (a) Overlay coatings (b) Diffusion coatings (c) Thermal or mechanical modification of Surfaces.

**TEXT BOOKS:**

1. R. K. Jain (2012), *Engineering Metrology*, 20<sup>th</sup> edition, Khanna Publishers, New Delhi, India.
2. J. R. Davis (2012), *Surface engineering for corrosion and wear resistance*, 3<sup>rd</sup> edition, Woodhead Publishers, USA.

**REFERENCE BOOKS:**

1. K. L. Narayana (2010), *Engineering Metrology*, 2<sup>nd</sup> edition, Scitech publishers, Hyderabad, India.
2. Manohar Mahajan (2011), *A Text Book of Metrology*, 1<sup>st</sup> edition, Dhanpath Rai, New Delhi, India.



**LIST OF EXPERIMENTS:**

1. Flash and fire points (open cup and closed cup method)
2. Viscosity determination by Red Wood and Saybolts method
3. I.C. Engines Valve / Port Timing Diagrams
4. I.C. Engines Performance Test (4 -Stroke Diesel Engines)
5. I.C. Engines Performance Test on 2-Stroke Petrol
6. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Petrol Engine and retardation and motoring test on 4- stroke diesel engine
7. I.C. Engines Heat Balance.
8. I.C. Engines Air/Fuel Ratio and Volumetric Efficiency
9. Performance Test on Variable Compression Ratio Engines, economical speed test.
10. Performance Test on Reciprocating Air – Compressor Unit
11. Study of Boilers
12. Dis-assembly / Assembly of Engines.

**Note:** Minimum 10 of the above experiments are to be conducted.

Minimum of 12 Exercises need to be performed

**I. METAL CASTING LAB**

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and permeability – 1
3. Moulding Melting and Casting - 1 Exercise

**II. WELDING LAB**

1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises  
(Water Plasma Device)

**III. MECHANICAL PRESS WORKING**

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

**IV. PROCESSING OF PLASTICS**

1. Injection Moulding
2. Blow Moulding

**Note:** Minimum 10 of the above experiments are to be conducted.

# **SYLLABI FOR VI SEMESTER**

**INDUSTRIAL MANAGEMENT AND PSYCHOLOGY**  
(Common to ME, EEE & CE)

Course Code: A1015

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4 - - 4

**UNIT - I**

**CONCEPTS OF MANAGEMENT AND ORGANISATION:** Functions of management, evolution of management thought, Taylor's scientific management, fayol's principles of management, Hertzberg's Maslow's hierarchy of human needs, systems approach to management.

**DESIGNING ORGANISATIONAL STRUCTURES:** Basic concepts related to organisation - departmentation and decentralization, types of mechanistic and organic structures of organisation (line organization, line and staff organization, functional organization).

**UNIT - II**

**PLANT LOCATION:** Definition, factors affecting the plant location, comparison of rural and urban sites, methods for selection of plant- matrix approach. Plant layout - definition, objectives, types of production, types of plant layout, various data analyzing forms travel chart.

**WORK STUDY:** Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts, difference between micromotion and memomotion studies. Work measurement- definition, time study, steps involved, equipment, different methods of performance rating, allowances, standard time calculation. Work Sampling - definition, steps involved, standard time calculations, differences with time study.

**UNIT - III**

**INTRODUCTION TO PERT / CPM :** Project management, network modeling-probabilistic model, various types of activity times estimation, programme evaluation review techniques, critical path, probability of completing the project, deterministic model, critical path method (CPM), critical path calculation, crashing of simple of networks.

**INSPECTION AND QUALITY CONTROL:** Types of inspections, statistical quality control, techniques, variables and attributes, assignable and non assignable causes, variable control charts, and R charts, attributes control charts, p charts and c charts. Acceptance sampling plan, single sampling and double sampling plans, OC curves. Introduction to TQM - quality circles, ISO 9000 series procedures.

**UNIT - IV**

**MATERIALS MANAGEMENT:** Objectives, inventory functions, types, associated costs, inventory classification techniques-ABC and VED analysis. Inventory control systems, continuous review system, periodical review system. Stores management and stores records. Purchase management, duties of purchase of manager, associated forms.

**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT:** Functions of HRM, job evaluation, different types of evaluation methods. Job description, merit rating, difference with job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes. Marketing, marketing vs. selling, marketing mix, product life cycle.

**UNIT - V**

**INDUSTRIAL PSYCHOLOGY:** Definition and concept, industrial psychology vs. personnel management, aims and objectives of industrial psychology, scope of industrial psychology, individual and group, individual differences in behavior, group dynamics, theory x and y, Hawthorne experiment, morale, motivation, working environmental conditions, industrial fatigue.

**TEXT BOOKS:**

1. O. P. Khanna (2004), *Industrial Engineering and Management*, Dhanpat Rai, New Delhi.

**REFERENCE BOOKS:**

1. Stoner, Freeman (2005), *Gilbert, Management*, 6<sup>th</sup> edition, Pearson Education, New Delhi.
2. Panner Selvam (2004), *Production and Operations Management*, Prentice Hall of India, New Delhi.
3. Ralph M. Barnes (2004), *Motion and Time Studies*, John Wiley and Sons.
4. L. S. Srinath (2000), *PERT / CPM*, affiliate East-West Press, New Delhi.
5. Gary Dessler (2002), *Human Resource Management*, Pearson Education Asia, India.

**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 forecasting ,Factors affecting the forecasting ,Types of forecasting and their uses - Demand patterns, General principles of forecasting, Forecasting techniques , Quantitative techniques , 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 preview systems and periodic preview systems MRP, ERP, JIT Systems, Basic treatment only.

**UNIT - III**

**LINE BALANCING:** Terminology methods of line balancing, RPW method, Largest candidate method Routing, Definition, Routing procedure, Factors effecting routing - Procedure for routing sheets.

**AGGREGATE PLANNING:** Definition, Aggregate planning strategies, Aggregate planning methods, Transportation model.

**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 procedure, Various Forms used in dispatching.

**FOLLOWUP:** Definition, Types of follow-up, Expediting, Definition, Expediting procedures, Applications of computers in planning and control.

**TEXT BOOKS:**

1. S. L. Narasimha (2010), *Production planning and inventory control*, 2<sup>nd</sup> edition, Prentice Hall of India Publishers, New Delhi, India.
2. Samuel Eilon(2011), *Elements of Production Planning and Control*, 2<sup>nd</sup> edition, Universal book corporation, Mumbai, India.
3. K. C. Jain, L. N. Agarwal (2012), *Production planning and control and Industrial Management*, 6<sup>th</sup> edition Khanna publishers, New Delhi, India.

**REFERENCE BOOKS:**

1. Ravi Shankar (2010), *Industrial Engineering and management*, Galgotia Publishers, New Delhi, India.
2. Panner Selvanm(2012), *Production Operation Management*, 2<sup>nd</sup> edition, Prentice Hall of India Publishers, New Delhi, India.
3. Joseph S. Martinich(2010), *Production and Operations Management*, John Willey & Sons, New York.

**UNIT - I**

**BEARINGS:** *Sliding Contact Bearing:* Types of Journal bearings, basic modes of Lubrication, Bearing construction, bearing design, bearing materials, Selection of lubricants. *Rolling Contact Bearings:* Types of rolling contact bearings, selection of bearing types, selection of bearing life, Design for cyclic loads and speeds, Static and dynamic loading of ball and roller bearings.

**UNIT - II**

**DESIGN OF IC ENGINE PARTS:** Connecting Rod: Thrust in connecting rod, stress due to whipping action on connecting rod ends, Cranks and Crank shafts, strength and proportions of over hung and center cranks, Crank pins, Crank shafts. Pistons, Forces acting on piston, Construction Design and proportions of piston. Cylinder, Cylinder Liners.

**UNIT - III**

**SPUR GEAR DRIVES:** Spur gears, Load concentration factor, and Dynamic load factor. Surface compressive strength, Bending strength, Design analysis of spur gears, Estimation of centre distance, module and face width, check for plastic deformation, Check for dynamic and wear considerations.

**HELICAL GEAR DRIVES:** Helical gears, Load concentration factor, and Dynamic load factor. Surface compressive strength, Bending strength, Design analysis of helical gears, Estimation of centre distance, module and face width, check for plastic deformation. Check for dynamic and wear considerations.

**UNIT - IV**

**DESIGN OF BEVEL GEAR:** Bevel gears, classification of Bevel Gears, Terms used in Bevel Gears, Determination of pitch angle for Bevel Gears, Proportions for Bevel Gears, Formative or Equivalent number of teeth for Bevel Gears, Strength of Bevel Gears, Forces acting on a Bevel Gear, Design of a shaft for Bevel Gears.

**DESIGN OF WORM GEARS:** Worm gears, properties of worm gears, Selection of materials, strength and wear rating of worm gears, Force analysis, Friction in worm gears, Thermal considerations

**UNIT - V**

**DESIGN OF POWER SCREWS:** Design of screw, Square, ACME, Buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures.

**MACHINE TOOL ELEMENTS:** Design of beds, slide ways, spindles- material selection, design of strength and rigidity of parts.

**TEXT BOOKS:**

1. V. Bandari (2011), *A Text Book of Design of Machine Elements*, 3<sup>rd</sup> edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.
2. R. L. Norton (2006), *Machine Design (An Integrated approach)*, 2<sup>nd</sup> edition, Pearson Publishers, Chennai, India.

**REFERENCE BOOKS:**

1. Shigley, J. E (2011), *Mechanical Engineering Design*, 9<sup>th</sup> edition, Tata McGraw-Hill, India.
2. S. M. D. Jalaludin (2011), *Machine Design*, 3<sup>rd</sup> edition, Anuradha Publishers, Chennai, India.
3. P. Kannaiah (2012), *Machine Design*, 2<sup>nd</sup> edition, Scitech Publications India Pvt. Ltd, New Delhi, India.

**DATA BOOKS PERMITTED:**

1. P. S. G. College of Technology (1978), *Design Data (Data Book for Engineers)*, 2<sup>nd</sup> edition, Published by Kalaikathir, Achchagim, Coimbatore, Chennai, India.
2. S. M. D. Jalaludin (2012), *Design Data Hand Book*, 1<sup>st</sup> edition, Anuradha Publishers, Kumbakonam, Chennai, India.

**UNIT - I**

**INTRODUCTION:** Modes and mechanisms of heat transfer, Basic laws of heat transfer, Applications of heat transfer. General three dimensional heat conduction equations in Cartesian, Cylindrical and Spherical coordinates. Different forms of general equation, Steady state and Transient heat transfer, Initial and boundary conditions.

**UNIT - II**

**CONDUCTION HEAT TRANSFER:** One dimensional steady state heat conduction through Homogeneous slabs, hollow cylinders and spheres, Overall heat transfer coefficient, Electrical analogy, Critical radius of insulation. Systems with variable thermal conductivity and Systems with internal heat generation. Extended surfaces (Fins) , Long, Short and insulated tips.

**ONE DIMENSIONAL TRANSIENT HEAT CONDUCTION:** Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems

**UNIT - III**

**CONVECTIVE HEAT TRANSFER:** Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis- Buckingham's Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer.

**FORCED CONVECTION:** External Flows, Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for Flat plates and Cylinders. Internal Flows, Concepts about Hydrodynamic and Thermal Entry Lengths, use of empirical correlations 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.

**UNIT - IV**

**BOILING AND CONDENSATION:** Regimes of Pool boiling and Flow boiling, Critical heat flux, Calculations on Nucleate Boiling. 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.

**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**

**RADIATION HEAT TRANSFER:** Emission characteristics , Laws of black-body radiation, Irradiation ,Total and monochromatic quantities , Laws of Planck, Wien, Kirchhoff, 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. Yunus A. Cengel (2012), *Heat Transfer a Practical Approach*, 4<sup>th</sup> edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
2. R. C. Sachdeva (2012), *Fundamentals of Engineering, Heat and Man Transfer*, 3<sup>rd</sup> edition, New Age, New Delhi, India.

**REFERENCE BOOKS:**

1. Holman (2012), *Heat Transfer (SI Units)*, 10<sup>th</sup> edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
2. P. S. Ghoshdastidar (2012), *Heat Transfer*, 2<sup>nd</sup> edition, Oxford University Press, New Delhi, India.
3. Incropera, Dewitt (2012), *Fundamentals of Heat Transfer*, 6<sup>th</sup> edition, John Wiley, UK.

**UNIT - I**

**INTRODUCTION TO FEM:** Basic concept, historical background, application of FEM, general description, comparison of FEM with other methods. Basic equations of elasticity, Stress, strain relations, Strain, Displacement relations.

**ONE DIMENSIONAL PROBLEM:** Finite element modeling coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

**UNIT - II**

**ANALYSIS OF TRUSSES:** Stiffness Matrix for plane truss and space truss elements, stress calculations.

**ANALYSIS OF BEAMS:** Hermite shape functions-Element stiffness matrix for two nodes, two degrees of freedom per node beam element, load vector, deflection, stresses.

**UNIT - III**

**2-D PROBLEMS:** CST-Stiffness matrix and load vector, Isoparametric element representation, Shape functions, convergence requirements, Problems.

**FINITE ELEMENT MODELLING** of Axisymmetric solids subjected to Axisymmetric loading with triangular elements. Two dimensional four noded isoparametric elements and numerical integration.

**UNIT - IV**

**STEADY STATE HEAT TRANSFER ANALYSIS:** one dimensional analysis of a fin and two dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion.

**UNIT - V**

**DYNAMIC ANALYSIS:** Formulation of finite element model, element matrices, Lumped and consistent mass matrices-evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.

**TEXT BOOKS:**

1. R. Tirupathi Chandrapatla (2011), *Introduction to Finite Elements in Engineering*, 4<sup>rd</sup> edition, Pearson Education, India.
2. S. S. Rao (2012), *The Finite Element Methods in Engineering*, 5<sup>th</sup> edition, Elsevier, USA.
3. V. David. Hutton (2010), *Fundamentals of finite elements analysis*, 1<sup>st</sup> edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.

**REFERENCE BOOKS:**

1. Chennakesava R. Alavala (2009), *Finite elements methods*, 1<sup>st</sup> edition, second reprint, Prentice Hall of India publishers, New Delhi, India.
2. J. N. Reddy (2010), *An introduction to Finite Element Method*, 3<sup>rd</sup> edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
3. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith , Ted G. Byrom (2009), *The Finite Element Method for Engineers*, 3<sup>rd</sup> edition, John Wiley & sons (ASIA) Pvt. Ltd., New York.



**DATABASE MANAGEMENT SYSTEMS**

Interdepartmental Elective - I

(Common to ME &amp; EEE)

Course Code: A1511

L	T	P	C
4	-	-	4

**UNIT - I**

**INTRODUCTION:** History of database systems, introduction to database management systems, database system applications, database systems versus file systems, view of data, data models, database languages- DDL & DML commands and examples of basic SQL queries, database users and administrators, transaction management, database system structure, application architectures.

**DATABASE DESIGN:** Introduction to database design and E-R diagrams, entities, attributes and entity sets, relationships and relationship sets, additional features of the E-R model, conceptual design with the E-R model, conceptual design for large enterprises.

**UNIT - II**

**THE RELATIONAL MODEL:** Introduction to the relational model, integrity constraints over relations, enforcing integrity constraints, querying relational data, logical database design: E-R to relational, introduction to views, destroying/altering tables and views.

**RELATIONAL ALGEBRA AND CALCULUS:** Preliminaries, relational algebra operators, relational calculus - tuple and domain relational calculus, expressive power of algebra and calculus.

**SQL:** Overview, the form of a basic SQL query, union, intersect and except operators, nested queries, aggregate operators, null values, complex integrity constraints in SQL, triggers and active databases, designing active databases.

**UNIT - III**

**SCHEMA REFINEMENT AND NORMAL FORMS:** Introduction to schema refinement, functional dependencies, reasoning about FDs. Normal forms: 1NF, 2NF, 3NF, BCNF, properties of decompositions, normalization, schema refinement in database design, other kinds of dependencies: 4NF, 5NF, DKNF, case studies.

**UNIT - IV**

**TRANSACTIONS MANAGEMENT:** Transaction concept, transaction state, implementation of atomicity and durability, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL, testing for serializability.

**CONCURRENCY CONTROL AND RECOVERY SYSTEM:** Concurrency control - lock based protocols, time-stamp based protocols, validation based protocols, multiple granularity, and deadlock handling. Recovery system - failure classification, storage structure, recovery and atomicity, log-based recovery, shadow paging, recovery with concurrent transactions, buffer management, failure with loss of non-volatile storage, advanced recovery techniques, remote backup systems.

**UNIT - V**

**OVERVIEW OF STORAGE AND INDEXING:** Data on external storage, file organizations and indexing, index data structures, comparison of file organizations, indexes and performance tuning. Tree structured indexing - intuition for tree indexes, indexed sequential access method (ISAM), B+ Trees - a dynamic tree structure.

**IBM DB2 FUNDAMENTALS\*:** DB2 product family - versions and editions, DB2 database and its objects, DB2 pure XML, backup and recovery, concurrency and its isolation levels, working with SQL, DB2 programming fundamentals - UDF, stored procedures.

\* This topic is designed in collaboration with IBM India Private Limited.

**TEXT BOOKS:**

1. Raghurama Krishnan, Johannes Gehrke (2007), *Database Management Systems*, 3<sup>rd</sup> edition, Tata McGraw Hill, New Delhi, India.

**REFERENCE BOOKS:**

1. Elmasri Navate (1994), *Fundamentals of Database Systems*, Pearson Education, India.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan (2005), *Database System Concepts*, 5<sup>th</sup> edition, McGraw-Hill, New Delhi, India.
3. Peter Rob, Carlos Coronel (2009), *Database Systems Design, Implementation and Management*, 7<sup>th</sup> edition, India.

**IMAGE PROCESSING**  
**Interdepartmental Elective - I**  
**(Common to ME & CE)**

Course Code: A1611

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>

**UNIT - I**

**FUNDAMENTALS OF IMAGE PROCESSING:** Image acquisition, image model, sampling, quantization, relationship between pixels, distance measures, connectivity, image geometry, photographic film.

**IMAGE TRANSFORMS:** A detail discussion on Fourier transform, DFT, FFT, properties. A brief discussion on WALSH transform, WFT, HADAMARD transform, DCT.

**UNIT - II**

**IMAGE ENHANCEMENT (by SPATIAL Domain Methods):** Histogram Processing - definition, equalization, matching, local enhancement, use of histogram statistics for image enhancement, Arithmetic and logical operations, pixel or point operations, size operations, Smoothing filters-mean, median, mode filters, sharpening spatial filtering.

**IMAGE ENHANCEMENT (by FREQUENCY Domain Methods):** Design of low pass, high pass, edge enhancement, smoothing filters in frequency domain. Butter worth filter, sharpening frequency domain filters, homomorphic filters in frequency domain.

**UNIT - III**

**IMAGE COMPRESSION:** Fundamentals, image compression models, elements of information theory, error-free compression, lossy compression, image compression standards.

**UNIT - IV**

**IMAGE SEGMENTATION:** Detection of discontinuities, edge linking and boundary detection, thresholding, region based segmentation, segmentation by morphological watersheds, the use of motion in segmentation.

**UNIT - V**

**COLOR IMAGE PROCESSING:** Fundamentals, models, pseudo color image, color transformation, smoothing, color segmentation, noise in color image, color image compression.

**MORPHOLOGY:** Dilation, erosion, opening, closing, hit-and-miss transform, boundary extraction, region filling, connected components, thinning, thickening, skeletons, pruning extensions to gray scale image application of morphology in image processing.

**TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods (2008), *Digital Image Processing*, Low Price Edition, Pearson Education, New Delhi, India.

**REFERENCE BOOKS:**

1. Arthur R. Weeks (1996), *Fundamentals of Electronic Image Processing*, Prentice Hall of India, New Delhi.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle (2008), *Image processing, Analysis and Machine vision*, Thomson Publications, India.

**DIGITAL ELECTRONICS AND MICROPROCESSORS**

**Interdepartmental Elective - I**

**(Common to ME & CE)**

Course Code: **A1453**

L	T	P	C
4	-	-	4

**UNIT - I**

**BINARY SYSTEMS:** Digital Computers and Digital Systems, Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Signed binary numbers, Binary codes, Binary Storage and Registers, Binary Logic.

**BOOLEAN ALGEBRA AND LOGIC GATES:** Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and properties of Boolean algebra, Boolean functions canonical and standard forms, other logic operations, Digital logic gates.

**UNIT - II**

**SIMPLIFICATION OF BOOLEAN FUNCTIONS:** The map method, Two, three, four and five variable maps, product of sums simplification, NAND and NOR implementation, other Two-level implementations, Don't-care conditions, Tabulation method, determination and selection of prime implicants.

**COMBINATIONAL LOGIC:** Introduction, design procedure, Adders, Subtractors, magnitude comparator, Decoders, Encoders, Multiplexers, Demultiplexers, Code converters and Parity Generators.

**UNIT - III**

**SEQUENTIAL LOGIC:** Introduction, latches, Flip-Flops, truth tables and excitation tables, triggering OF flip-flops, Registers, shift Registers, Ripple counters, shift register counters (Ring, Johnson and LFSR Counters).

**UNIT - IV**

**8085 MICROPROCESSOR:** Introduction to microprocessors, Architecture of 8085, Pin Diagram of 8085, Timing Diagram, Addressing Modes, Instruction Set, Interrupt structure of 8085.

**UNIT - V**

**MICROPROCESSOR PERIPHERAL INTERFACING:** Methods of Interfacing I/O Ports: I/O Mapped I/O, Memory Mapped I/O, Programmable Peripheral interface 8255 – Various Modes of Operation and Interfacing to 8085, Need for DMA, DMA data transfer Method, Interfacing with DMA Controller 8257.

**TEXT BOOKS:**

1. M. Morris Mano (2012), *Digital Design*, 4<sup>th</sup> edition, Pearson Education/Prentice Hall of India, New Delhi, India.
2. Ramesh S. Goankar(2011), *Microprocessor Architecture, Programming and Applications with the 8085*, Prentice Hall of India, India.

**REFERENCE BOOKS:**

1. C. V. S. Rao (2010), *Switching Theory and Logic Design*, Pearson Education, India.
2. K. Uday Kumar, B. S. Uma Shankar (2008), *The 8085 Microprocessor Architecture, Programming and Interfacing*, Pearson Publications, India.

**ENERGY MANAGEMENT**  
**Interdepartmental Elective - I**  
**(Common to ME & CE)**

Course Code: **A1228**

**L T P C**  
**4 - - 4**

**UNIT - I**

**INTRODUCTION:** Principles of Energy Management, Managerial Organization. Functional Areas for Manufacturing Industry, Process Industry, Commerce, Government. Role of Energy Manager in each of the organization. Initiating, Organizing and Managing Energy Management Programs.

**UNIT - II**

**ENERGY AUDIT:** Definition and Concepts, Types of Energy Audits, Basic Energy Concepts. Resources for Plant Energy Studies, Data Gathering, Analytical Techniques. Energy Conservation: Technologies for Energy Conservation, Design for Conservation of Energy materials, energy flow networks, critical assessment of energy usage, formulation of objectives and constraints, synthesis of alternative options and technical analysis of options, process integration.

**UNIT - III**

**ECONOMIC ANALYSIS:** Scope, Characterization of an Investment Project, Types of Depreciation, Time Value of money, budget considerations, Risk Analysis.

**UNIT - IV**

**METHODS OF EVALUATION OF PROJECTS:** Payback, Annualized Costs, Investor's Rate of return, Present worth, Internal Rate of Return. Pros and Cons of the common methods of analysis, replacement analysis. Energy Consultant: Need of Energy Consultant, Consultant Selection Criteria.

**UNIT - V**

**ALTERNATIVE ENERGY SOURCES:** Solar Energy: Types of devices for Solar Energy Collection, Thermal Storage System. Control Systems, Wind Energy, Availability, Wind Devices, Wind Characteristics, Performance of Turbines and systems.

**TEXT BOOKS:**

1. W. R. Murphy, G. McKay (2008), *Energy Management*, 1<sup>st</sup> edition, B.S. Publications, New Delhi.

**REFERENCE BOOKS:**

1. B. Smith (2007), *Energy Management Principles*, 1<sup>st</sup> edition, Pergamon Press, Inc., England.

**FATIGUE AND FRACTURE MECHANICS**  
(Interdepartmental Elective - I)

Course Code: A1735

L	T	P	C
4	-	-	4

**UNIT - I**

**FATIGUE OF STRUCTURES:** S-N Curves, Endurance limit, Effect of mean stress, Notches and stress concentrations, Neuber's stress concentration factors, Plastic stress concentration factor, Notched S-N curves.

**DESIGN OF COMPONENTS:** Goodman, Gerber and Soderberg relations and diagrams, Modified Goodman Diagram, Design of components subjected to axial, bending, torsion loads and combination of them.

**UNIT - II**

**STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR:** Low cycle and high cycle fatigue, Coffin Manson's relation, Transition life, cyclic strain hardening and softening.

**LOAD ASPECTS:** Analysis of load histories, Cycle counting techniques, Cumulative damage, Miner's theory, other theories.

**UNIT - III**

**PHYSICAL ASPECTS OF FATIGUE:** Phase in fatigue life, Crack initiation, Crack growth, Final fracture, Dislocations, Fatigue fracture surfaces.

**FRACTURE MECHANICS:** Strength of cracked bodies, Potential energy and surface energy, Griffith's theory, Irwin-Orwin extension of Griffith's theory to ductile materials.

**UNIT - IV**

**STRESS ANALYSIS:** Stress analysis of cracked bodies, Effect of thickness on fracture toughness, Stress intensity factors for typical geometries. Introduction of finite element approach for crack propagation studies.

**UNIT - V**

**FATIGUE DESIGN AND TESTING:** Safe life and fail-safe design philosophies, Importance of fracture mechanics in aerospace structure, Application to composite materials structures.

**TEXT BOOKS:**

1. J. F. Knott (1983), *Fundamentals of Fracture Mechanics*, Butter Worth & Co., Publishers Ltd., London.
2. C. G. Sih (1989) *Mechanics of Fracture*, Vol. I, Sijthoff and Noordhoff International Publishing Co., Netherlands.

**REFERENCE BOOKS:**

1. W. Barrois, E. L. Ripley (1983), *Fatigue of Aircraft Structures*, Pergamum Pres., Oxford, USA.

**AIR POLLUTION AND CONTROL METHODS**

**Interdepartmental Elective - I**

**(Common to ME, EEE & AE)**

Course Code: **A1148**

L	T	P	C
4	-	-	4

**UNIT - I**

**AIR POLLUTION:** Definitions, scope, significance and episodes, air pollutants – classifications - natural and artificial - primary and secondary, point and non- point, line and areal sources of air pollution- stationary and mobile sources. Effects of air pollutants on man, material and vegetation: global effects of air pollution - green house effect, heat islands, acid rains, ozone holes etc.

**UNIT - II**

**THERMODYNAMICS AND KINETICS OF AIR - POLLUTION:** Applications in the removal of gases like SO<sub>x</sub>, NO<sub>x</sub>, CO, HC etc., air-fuel ratio. Computation and Control of products of combustion. Meteorology and plume Dispersion,

**UNIT - III**

**PROPERTIES OF ATMOSPHERE:** Heat, Pressure, Wind forces, Moisture and relative Humidity, Influence of Meteorological phenomena on Air Quality-wind rose diagrams.

**LAPSE RATES:** Pressure Systems, Winds and moisture plume behavior and plume Rise Models; Gaussian Model for Plume Dispersion.

**UNIT - IV**

**CONTROL OF PARTICULATES:** Control at Sources, Process Changes, Equipment modifications, Design and operation of control. Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators. General Methods of Control of NO<sub>x</sub> and Sox emissions – In-plant Control Measures, process changes, dry and wet methods of removal and recycling.

**UNIT - V**

**AIR QUALITY MANAGEMENT:** Monitoring of SPM, SO<sub>2</sub>; NO and CO Emission Standards.

**TEXT BOOKS:**

1. M. N. Rao, H. V. N. Rao (1988), *Air pollution*, Tata McGraw Hill Education, New Delhi, India.
2. C. S. Rao (2006), *Environmental Pollution control Engineering*, New age international, New Delhi, India.

**REFERENCE BOOKS:**

1. R. K. Trivedy, P. K. Goel (2003), *Introduction to Air pollution*, ABD Publications, New Delhi, India.
2. Wark, Warner (1998), *Air pollution its origin and control*, Addison-Wesley, New York.

**LIST OF EXPERIMENTS:**

**Minimum twelve experiments from the following:**

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer through pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzmann Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

**LIST OF EXPERIMENTS:**

**PART - A:**

1. Measurement of lengths, heights, diameters by Vernier calipers micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth, Vernier calipers and checking the chordal addendum and chordal height of spur gear.
4. Machine tool "alignment of test on the lathe.
5. Machine tool alignment test on milling machine.
6. Tool makers microscope and its application
7. Angle and taper measurements by Bevel protractor, Sine bars, etc.
8. Use of spirit level in finding the flatness of surface plate.
9. Thread measurement by two wire/ three wire method or Tool makers' microscope.
10. Surface roughness measurement by Taly Surf.

**PART - B:**

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper, Planning machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine
3. Thread cutting and knurling on -lathe machine.
4. Drilling and Tapping
5. Shaping and Planning
6. Slotting
7. Milling
8. Cylindrical Surface Grinding
9. Grinding of Tool angles.

**Note:** Minimum 12 of the above experiments are to be conducted.



# **SYLLABI FOR VII SEMESTER**

**OPERATIONS RESEARCH**  
**(Common to ME, CSE, IT & ECE)**

Course Code: **A1330**

**L T P C**  
**4 - - 4**

**UNIT - I**

**INTRODUCTION TO OPERATIONS RESEARCH:** Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem. Simplex Method, Artificial variables Techniques, big -M method, two -phase simplex method, degeneracy and unbound solutions.

**UNIT - II**

**TRANSPORTATION PROBLEM:** Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions, North-West corner rule, least cost method and Vogel's approximation method. Optimality test - MODI method.

**ASSIGNMENT MODEL:** Formulation, Hungarian method for optimal solution, solving unbalanced problem, Traveling salesman problem as assignment problem.

**UNIT - III**

**SEQUENCING MODELS:** Solution of Sequencing Problem, Processing n Jobs through two machines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines.

**QUEUING THEORY:** Introduction, Single Channel, Poisson arrivals, exponential service times with infinite population and finite population models.

**UNIT - IV**

**REPLACEMENT MODELS:** Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly, individual replacement policy, group replacement policy.

**INVENTORY MODELS:** Inventory costs, Models with deterministic demand model: (a) Demand rate uniform and production rate infinite, (b) Demand rate non-uniform and production rate infinite, (c) Demand rate uniform and production rate finite.

**UNIT - V**

**GAME THEORY:** Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle, Rectangular games without saddle point, mixed strategy for 2 X 2 games.

**DYNAMIC PROGRAMMING:** Characteristics of dynamic programming, Dynamic programming approach for priority management employment smoothening, Capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

**TEXT BOOKS:**

1. A. M. Natarajan, P. Balasubramani, A. Tamilarasi (2006), *Operations Research*, Pearson Education, India.
2. S. D. Shama (2009), *Operation Research*, Tata McGraw Hill, New Delhi.

**REFERENCE BOOKS:**

1. J. K. Sharma (2007), *Operations Research – Theory and Applications*, 3<sup>rd</sup> edition, Macmillan India Ltd, India.
2. R. Panneerselvam (2008), *Operations Research*, 2<sup>nd</sup> edition, Prentice Hall of India, India.
3. F. S. Hillier, G. J. Lieberman (2007), *Introduction to Operations Research*, 8<sup>th</sup> edition, Tata McGraw Hill, New Delhi, India.

## B. Tech. ME VII SEMESTER

### CAD / CAM

Course Code: A1331

L	T	P	C
3	1	-	4

#### UNIT - I

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

**COMPUTER GRAPHICS:** Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

#### UNIT - II

**GEOMETRIC MODELING:** Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

**DRAFTING AND MODELING SYSTEMS:** Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.

#### UNIT - III

**NUMERICAL CONTROL:** NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

**GROUP TECH:** Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

#### UNIT - IV

**COMPUTER AIDED QUALITY CONTROL:** Terminology in quality control, the computer in QC, contact inspection methods, non contact inspection methods-optical, non contact inspection methods-non optical, computer aided testing, integration of CAQC with CAD/CAM.

#### UNIT - V

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS:** Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

#### TEXT BOOKS:

1. A. Zimmers, P. Groover (2010), *CAD / CAM*, 3<sup>rd</sup> edition, Prentice Hall of India, New Delhi.
2. Ibrahim Zeid(2011), *CAD / CAM Theory and Practice*, 4<sup>th</sup> edition, Tata McGraw Hill education (P) Ltd, New Delhi, India.

#### REFERENCE BOOKS:

1. P. Groover(2011), *Automation, Production systems and Computer integrated Manufacturing*, 3<sup>rd</sup> edition, Pearson Publications, India.
2. Radhakrishnan, Subramanian (2009), *CAD / CAM / CIM*, New Age Inetrnational Pvt. Ltd, New Delhi, India.
3. Alavala, C. R (2012), *CAD/CAM: Concepts and Applications*, 1<sup>st</sup> edition, Prentice Hall of India, New Delhi, India.

**UNIT - I**

**INTRODUCTION:** Definition , Basic principles of measurement, Measurement systems, generalized configuration and functional descriptions of measuring instruments, examples. Dynamic performance characteristics, sources of error, Classification and elimination of error.

**MEASUREMENT OF DISPLACEMENT:** Theory and construction of various transducers to measure displacement ,Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

**UNIT - II**

**MEASUREMENT OF PRESSURE:** Units, classification, different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement, Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

**MEASUREMENT OF LEVEL:** Direct method, Indirect methods, capacitive, ultrasonic, magnetic, Bubbler level indicators.

**FLOW MEASUREMENT:** Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot, wire anemometer, Laser Doppler Anemometer (LDA).

**UNIT - III**

**MEASUREMENT OF SPEED:** Mechanical Tachometers, Electrical tachometers, Stroboscope, Noncontact type of tachometer.

**MEASUREMENT OF ACCELERATION AND VIBRATION:** Different simple instruments, Principles of Seismic instruments, Vibrometer and accelerometer using this principle.

**UNIT - IV**

**STRESS STRAIN MEASUREMENTS:** Various types of stress and strain measurements , electrical strain gauge , gauge factor , method of usage of resistance strain gauge for bending compressive and tensile strains , usage for measuring torque, Strain gauge Rosettes.

**MEASUREMENT OF TEMPERATURE:** Classification , Ranges , Various Principles of measurement , Expansion, Electrical Resistance , Thermistor , Thermocouple , Pyrometers, Temperature Indicators.

**UNIT - V**

**MEASUREMENT OF HUMIDITY:** Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

**ELEMENTS OF CONTROL SYSTEMS:** Introduction, Importance, Classification, Open and closed systems Servomechanisms, Examples with block diagrams, Temperature, speed & position control systems.

**TEXT BOOKS:**

1. D.S. Kumar(2011), *Mechanical Measurements and Controls*, 4<sup>th</sup> edition, Metropolitan Book Co. Pvt Ltd., New Delhi, India.
2. A. K. Tayal (2004), *Instrumentation and mechanical Measurements*, 2<sup>nd</sup> edition, Galgotia Publications, New Delhi, India.

**REFERENCE BOOKS:**

1. Er. R. K. Jain (2011), *Mechanical and Industrial Measurements*, 12<sup>th</sup> edition, Khanna Publishers, New Delhi, India.
2. Chennakesava R. Alavala(2010), *Principles of Industrial Instrumentation and Control Systems*, 1<sup>st</sup> edition, Cengage Learning, New Delhi, India.
3. B. C. Nakra, K. K. Choudhary (2010), *Instrumentation, measurement and analysis*, 4<sup>th</sup>, Tata McGraw-Hill, New Delhi, India.

**UNIT - I**

**INTRODUCTION TO REFRIGERATION:** Necessity and applications, Unit of refrigeration and C.O.P, Mechanical Refrigeration , Types of Ideal cycles of refrigeration. Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems, Actual air refrigeration system problems, and Refrigeration needs of Air crafts.

**UNIT - II**

**VAPOUR COMPRESSION REFRIGERATION:** working principle and essential components of the plant , simple Vapour compression refrigeration cycle, COP ,Representation of cycle on T-S and p-h charts ,effect of sub cooling and super heating , cycle analysis , Actual cycle Influence of various parameters on system performance , Use of p-h charts , numerical Problems.

**VAPOUR ABSORPTION SYSTEM:** Calculation of max COP ,description and working of NH<sub>3</sub> , water system and Li Br ,water ( Two shell & Four shell) System. Principle of operation Three Fluid absorption system, salient features.

**UNIT - III**

**SYSTEM COMPONENTS:** Evaporators, classification, Working Principles Expansion devices, Types, Working Principles.

**REFRIGERANTS:** Desirable properties, classification refrigerants used Nomenclature, Ozone Depletion, and Global Warming.

**STEAM JET REFRIGERATION SYSTEM:** Working Principle and Basic Components, Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

**UNIT - IV**

**INTRODUCTION TO AIR CONDITIONING:** Psychometric Properties & Processes, Characterization of Sensible and latent heat loads, Need for Ventilation, Consideration of Infiltration, Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP.

**UNIT - V**

Requirements of human comfort and concept of effective temperature- Comfort chart, Comfort Air conditioning, Requirements of Industrial air conditioning, Air conditioning.

**AIR CONDITIONING SYSTEM** - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers fans and blowers. Heat Pump, Heat sources, different heat pump circuits.

**TEXT BOOKS:**

1. Domkundwar, S. C. Arora (2009), *A Course in Refrigeration and Air conditioning*, 6<sup>th</sup> edition, Dhanpatrai Publications, New Delhi, India.
2. C.P. Arora(2009), *Refrigeration and Air Conditioning*, 3<sup>rd</sup> edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.

**REFERENCE BOOKS:**

1. Manohar Prasad(2010), *Refrigeration and Air Conditioning*, Revised 2<sup>nd</sup> edition, New Age International Pvt. Ltd., New Delhi, India.
2. S. S. Thipse(2005), *Refrigeration and Air Conditioning*, 1<sup>st</sup> edition, Jaico Publishing House, Mumbai, India.
3. Ananthanarayanan(2009), *Basic Refrigeration and Air Conditioning*, 3<sup>rd</sup> edition, Tata McGraw Hill, New Delhi, India.

**HUMAN VALUES AND ETHICS**

**Interdepartmental Elective - II  
(Common to ME, EEE, AE & CE)**

Course Code: **A1016**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>

**UNIT - I**

**HUMANVALUES:** Morals, values and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, character and spirituality.

**UNIT - II**

**ENGINEERING ETHICS:** Senses of 'Engineering Ethics', variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, models of professional roles, theories about right action, self-interest, customs and religion, uses of ethical theories.

**UNIT - III**

**ENGINEERING AS SOCIAL EXPERIMENTATION:** Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study.

**UNIT - IV**

**SAFETY, RESPONSIBILITIES AND RIGHTS:** Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the Three Mile Island and Chernobyl case studies. Collegiality and loyalty, respect for authority, collective bargaining, confidentiality, conflicts of interest, occupational crime, professional rights, employee rights, Intellectual Property Rights (IPR), discrimination.

**UNIT - V**

**GLOBAL ISSUES:** Multinational corporations, environmental ethics, computer ethics, weapons development, engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of ethics like ASME, ASCE, IEEE, institution of engineers (India), Indian institute of materials management, institution of electronics and telecommunication engineers (IETE),India, etc.

**TEXT BOOKS:**

1. Mike Martin, Roland Schinzing(1996), *Ethics in Engineering*, McGraw-Hill, New York.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S (2004), *Engineering Ethics*, Prentice Hall of India, New Delhi, India.

**REFERENCE BOOKS:**

1. Charles D. Fleddermann(2004), *Engineering Ethics*, Pearson Education / Prentice Hall, New Jersey.
2. Charles E Harris, Michael S. Protchard, Michael J Rabins(2000), *Engineering Ethics - Concepts and Cases*, Wadsworth Thompson Learning, United States.
3. John R Boatright(2003), *Ethics and the Conduct of Business*, Pearson Education, New Delhi.
4. Edmund G Seebauer and Robert L Barry, (2001), *Fundamentals of Ethics for Scientists and Engineers*, Oxford University Press, New York.

**HUMAN RESOURCE MANAGEMENT**

**Interdepartmental Elective - II**

**(Common to ME, EEE, AE & CE)**

Course Code: **A1017**

L	T	P	C
4	-	-	4

**UNIT - I**

**INTRODUCTION HUMAN RESOURCE MANAGEMENT:** Introduction and significance of HRM, Scope, functions of HRM, changing environment of HRM and Challenges. Human Resource Planning, Objectives, Factors influencing Human Resource planning, HR Planning Process.

**UNIT - II**

**JOB ANALYSIS AND RECRUITMENT:** Process and Sources of Recruitment; Selection, process of selection and techniques, Retention of Employees.

**UNIT - III**

**HUMAN RESOURCES DEVELOPMENT:** Training Vs Development, Need, Process of training, Methods of training, Training Evaluation, Career planning, Performance Management System, Methods of Appraisal, Common Errors.

**UNIT - IV**

**COMPENSATION MANAGEMENT:** Concepts and components of wages, Factors influencing wage fixation, Job evaluation, Methods of payment, Incentives and Fringe benefits.

**UNIT - V**

**MANAGING INDUSTRIAL RELATIONS:** Components of Industrial Relation, Trade Unions, functions of Trade Union, Employee Participation, Importance and Schemes, Collective Bargaining, Grievance Redressal, Industrial Dispute Settlement machinery.

**TEXT BOOKS:**

1. Biswajeet Pattnayak (2009), *Human Resource Management*, Prentice hall of India, New Delhi, India.
2. R. Wayne Mondy and Robert M. Noe (2009), *Human Resource Management*, Pearson, India.

**REFERENCE BOOKS:**

1. Aswathappa. K. (2007), *Human Resources and Personnel Management*, Tata MC Graw Hill, New Delhi, India.
2. Monappa. A, Saiyadain. M. (1979), *Personnel Management*, Tata Mc Graw Hill, New Delhi, India.
3. C. B. Mamoria (2003), *Personnel Management*, Himalaya Publishing House, India.

**ENTREPRENEURSHIP**  
**Interdepartmental Elective - II**  
**(Common to ME, EEE, AE & CE)**

Course Code: **A1018**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>

**UNIT - I**

**ENTREPRENEURSHIP:** Importance and role of entrepreneurship, Characteristics of entrepreneurship, Qualities of an entrepreneur, Functions of entrepreneur; Theories of entrepreneurship, Stimulants of entrepreneurship and Barriers to entrepreneurship, Ethics and Social Responsibility, Role of entrepreneur in economic development.

**UNIT - II**

**INSTITUTIONAL SUPPORT:** Role of Government; Role of IDBI, SIDBI, SIDO, NIESBUD, SISI, DIC, Entrepreneurship Development Institute, MSMEs.

**UNIT - III**

**WOMEN ENTREPRENEURSHIP:** Role & Importance, Functions of women entrepreneur, Profile of Indian Women Entrepreneur, Problems of Women Entrepreneurs, Women Entrepreneurship Development in India and in Foreign Countries.

**UNIT - IV**

**PROJECT MANAGEMENT:** Concept of project and classification of project identification, project formulation - project report - project design, Project appraisal - profitability appraisal - project planning - social cost benefit analysis - financial analysis and project financing.

**UNIT - V**

**TRAINING:** Designing appropriate training programmes to inculcate Entrepreneurial Spirit, significance of entrepreneurial training, Training for New and Existing Entrepreneurs, Feedback and Performance of Trainees.

**TEXT BOOKS:**

1. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), *Entrepreneurship*, Tata Mc Graw Hill, New Delhi.

**REFERENCE BOOKS:**

1. Bholanath Datta (2009), *Entrepreneurship*, Excel publications, India.
2. David H Holt (2010), *Entrepreneurship*, Prentice hall of India, New Delhi, India.



**BUSINESS COMMUNICATION**  
**Interdepartmental Elective - II**  
**(Common to ME, EEE, AE & CE)**

Course Code: A1019

L	T	P	C
4	-	-	4

**UNIT - I**

**INTRODUCTION TO MANAGERIAL COMMUNICATION:** Meaning, Importance and objectives, Principles of Communication, Forms of communication, Communication Process, Barriers To effective communication, Gateways to effective communication.

**UNIT - II**

**NONVERBAL COMMUNICATION:** Body Language, Gestures, Postures, Facial Expressions, Dress Code. Listening and Speaking Skills, Probing questions, Observation, Business and Social etiquette.

**UNIT - III**

**MANAGERIAL SPEECHES:** Principles of Effective Speech & Presentations. Technical and Non-technical presentations. Speech of introduction, speech of thanks, occasional speech, theme speech, Use of audio visual aids.

**UNIT - IV**

**INTERVIEW TECHNIQUES:** Mastering the art of conducting and giving interviews, Placement interviews, discipline/technical interviews, appraisal interviews, exit Interviews. *Group communication:* Importance, Meetings, group discussions, Video conferencing.

**UNIT - V**

**INTRODUCTION TO BUSINESS CORRESPONDENCE:** *Business letters:* Enquiries, Circulars, Quotations, Orders, Acknowledgments, Executions, Complaints, Persuading letters, Sales letters, Job application letters, Bio-data, Covering Letter, Interview Letters, Letter of Reference, Memos, minutes, Circulars and Notices. *Reports:* Types of Business Reports - Format, Choice of vocabulary, Coherence, paragraph writing, organization reports by individual, Report by committee.

**TEXT BOOKS:**

1. Lesikar R. V, Flatley M. E (2005), *For Empowering the Internet Generation*, Tata McGraw Hill Publishing Company Ltd., New Delhi, India.
2. Ludlow. R, Panton. F (1998), *The Essence of Effective Communications*, Prentice Hall of India Pvt. Ltd., New Delhi, India.

**REFERENCE BOOKS:**

1. Adair .J (2003), *Effective Communication*, Pan Macmillan, London.
2. Pan Mcmillan Thill J. V, Bovee G. L (1993), *Excellence in Business Communication*, Tata McGraw Hill, New York.
3. Bowman J.P, Branchaw P. P (1987), *Business Communications: From Process to Product*, Dryden Press, Chicago.

**INTELLECTUAL PROPERTY AND PATENT RIGHTS**

**Interdepartmental Elective - II  
(Common to ME, EEE, AE & CE)**

Course Code: **A1020**

L	T	P	C
4	-	-	4

**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 regisffation, 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 trade secrets law.

**TEXT BOOKS:**

1. Deborah. E. Bouchoux (2009), *Intellectual property*, Cengage learning, India.
2. Deborah. E. Bouchoux (2001), *Protecting your companies intellectual property*, AMACOM, USA.

**REFERENCE BOOKS:**

1. Prabudda ganguli (2003), *Intellectual property right*, Tata McGraw Hill Publishing company ltd., India.
2. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), *Entrepreneurship*, Tata Mc Graw Hill, India.

**PROJECT PLANNING AND MANAGEMENT**

**Interdepartmental Elective - II**

**(Common to ME, EEE, AE & CE)**

Course Code: **A1021**

L	T	P	C
4	-	-	4

**UNIT - I**

**PERT AND CPM** : Introduction, origin of PERT and CPM, planning, scheduling and controlling, bar charts, milestone charts, weaknesses in bar charts, PERT and CPM networks comparison, event, activity, rules for drawing networks, numbering the events (Fulkerson's law), dummy activities.

**UNIT - II**

**CPM - PERT NETWORK ANALYSIS** : Time estimate, expected time, earliest allowable occurrence time, latest allowable occurrence time, slack, project duration, probability of completion, start and finish time estimates, floats, project scheduling, critical and sub-critical path. Updating - process of updating, when to update.

**UNIT - III**

**CPM COST MODEL & RESOURCES ALLOCATIONS, RESOURCE SCHEDULING** : Cost analysis, direct and indirect costs, operation time, normal and crash times and costs, optimizing project cost, crash limit, free float limit, optimization. Resource smoothening, resource leveling.

**UNIT - IV**

**MANAGEMENT**: Scope of construction management, significance of construction management, concept of scientific management, psychology in management, a historical account of management philosophy, qualities of manager, the roles/functions performed by effective and competent managers, the manager - as a decision maker, as a motivator, as a communication-link, as a conflict resolver, as a well wisher of co-employees and the employer etc.

**UNIT - V**

**ORGANIZATION**: Types of organization, merits and demerits of different types of organization, authority, policy, recruitment process and training; development of personnel department; labor problems; labor legislation in India; 'workmen's compensation act of 1923 and minimum wages act of 1948', and subsequent amendments. Safety in construction.

**TEXT BOOKS:**

1. Punmia, Khandelwal (2006), *Project planning and control with PERT and CPM*, 3<sup>rd</sup> edition, Laxmi Publications, New Delhi, India.

**REFERENCE BOOKS:**

1. L. S. Srinath (1975), *PERT and CPM*, 2nd Edition, Afflicted East West Press Pvt. Ltd, New Delhi, India.
2. U. K. Shrivastava (1999), *Construction Planning and Management*, Galgotia Publications Pvt. Ltd., New Delhi.

**AUTOMOBILE ENGINEERING**  
(Professional Elective - I)

Course Code: A1334

L T P C  
3 1 - 4

**UNIT - I**

**INTRODUCTION :** Components of four wheeler automobile , chassis and body , power unit , power transmission , rear wheel drive, front wheel drive, 4 wheel drive , types of automobile engines, engine construction, turbo charging and super charging , engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps , crank case ventilation , engine service, reborning, decarbonisation, Nitriding of crank shaft..

**UNIT - II**

**FUEL SYSTEM:** S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump, filters, carburettor, types, air filters, petrol injection.

**C.I. ENGINES:** Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Emission from Automobiles, Pollution standards National and international, Pollution Control, Techniques, Multipoint fuel injection for SI Engines.

**UNIT - III**

**COOLING SYSTEM :** Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System ,Radiators , Types , Cooling Fan - water pump, thermostat, evaporating cooling , pressure sealed cooling , antifreeze solutions.

**IGNITION SYSTEM:** Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug, Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers, spark advance and retard mechanism.

**UNIT - IV**

**TRANSMISSION SYSTEM:** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel, gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft , Hotch , Kiss drive, Torque tube drive, universal joint, differential rear axles , types , wheels and tiers.

**BRAKING SYSTEM:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes

**UNIT - V**

**STEERING SYSTEM:** Steering geometry, camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism , Ackerman steering mechanism, Davis steering mechanism, steering gears , types, steering linkages.

**SUSPENSION SYSTEM:** Objects of suspension systems, rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**TEXT BOOKS:**

1. Kirpal Singh (2012), *Automobile Engineering - Vol. 1 &2*, 12<sup>th</sup> edition, standard publishers, New Delhi, India.
2. William Crouse (2012), *Automobile Engineering (SIE)*, 10<sup>th</sup> edition, Tata McGraw hill education (P) Ltd, New Delhi, India.

**REFERENCE BOOKS:**

1. B. S. Narang (2011), *Automobile Engineering*, 5<sup>th</sup> edition, Karman publishers, New Delhi, India.
2. J. B. Gupta (2012), *Automobile Engineering*, satya prakhashan, New Delhi, India.

**RAPID PROTOTYPING**  
(Professional Elective - I)

Course Code: A1335

L	T	P	C
3	1	-	4

**UNIT - I**

**INTRODUCTION:** Definition of Prototype, Types of prototypes, Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, and classification of RP Systems.

**UNIT - II**

**STEREO LITHOGRAPHY SYSTEMS:** Principle, Process parameters, process details, Data preparation, data files and machine details, Application.

**SELECTIVE LASER SINTERING:** Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Fusion Deposition Modeling: Principle, Process parameters, Path generation, Applications.

**UNIT - III**

**SOLID GROUND CURING:** Principle of operation, Machine details, Applications, Laminated Object Manufacturing: Principle of operation, LOW materials, process details, application.

**CONCEPTS MODELERS:** Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system – 5, object Quadra systems, Laser Engineering Net Shaping (LENS).

**UNIT - IV**

**RAPID TOOLING:** Indirect Rapid tooling, Silicon rubber tolling, Aluminium filled epoxy tooling, Spray metal tooling, cast kirksite, 3D Keltool, Direct Rapid Tooling - Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling Vs Hard tooling.

**UNIT - V**

**SOFTWARE FOR RP:** STL files, Overview of Solid view, magics, magic communicator, Internet based software, Collaboration tools, Rapid Manufacturing Process Optimization: factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation.

**ALLIED PROCESSES:** Vacuum, casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

**TEXT BOOKS:**

1. Fiham D.T, Dinjoy S. S (2002), *Rapid manufacturing*, 4<sup>th</sup> edition, Verlog, London.
2. Paul F. Jacobs (1996), *Stereo lithography and other RP and M Technologies*, 3<sup>rd</sup> edition, SME, New York.

**REFERENCE BOOKS:**

1. C. K. Chua, K. F. Leong, C. S. Lim (2010), *Rapid Prototyping - Principles and Applications*, 2<sup>nd</sup> edition, Yesdee publications Pvt. Ltd., Mumbai, India.

**MECHATRONICS**  
**(Professional Elective - I)**

Course Code: **A1336**

**L T P C**  
**3 1 - 4**

**UNIT - I**

**INTRODUCTION:** Definition, Trends, Control Methods: Standalone, PC Based (Real Time Operating Systems, Graphical User Interface, and Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

**PRECISION MECHANICAL SYSTEMS :** Pneumatic Actuation Systems , Electro-pneumatic Actuation Systems , Hydraulic Actuation Systems , Electro-hydraulic Actuation Systems - Timing Belts , Ball Screw and Nut , Linear Motion Guides , Linear Bearings , Harmonic Transmission , Bearings- Motor / Drive Selection.

**UNIT - II**

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

**UNIT - III**

**ELECTRONIC INTERFACE SUBSYSTEMS :** TTL, CMOS interfacing - Sensor interfacing , Actuator interfacing , solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes , circuit breakers , over current sensing , resettable fuses , thermal dissipation , Power Supply - Bipolar transistors / mosfets

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

**UNIT - IV**

**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).

**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, 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.

**TEXT BOOKS:**

1. W. Bolton (2012), *Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering*, 4<sup>th</sup> edition, Pearson Education, New Delhi, India.
2. N. Shanmugam (2010), *Mechatronics*, 2<sup>nd</sup> edition, Anuradha Agencies Publishers, Chennai, India.
3. R. K. Rajput (2012), *A text book of Mechatronics*, 1<sup>st</sup> edition, S. Chand & Company Ltd., New Delhi, India.

**REFERENCE BOOKS:**

1. Bradley (2010), *Mechatronics*, 4<sup>th</sup> edition, prentice Hall of India, New Delhi, India.
2. HMT. Ltd (1998), *Mechatronics*, 1<sup>st</sup> edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, India.
3. M. D. Singh, J. G. Joshi (2011), *Mechatronics*, 1<sup>st</sup> edition, Prentice Hall of India Pvt Ltd., New Delhi, India.

**ROBOTICS**  
**Professional Elective - I**  
**(Common to ME, CSE & IT)**

Course Code: A1337

**L T P C**  
**3 1 - 4**

**UNIT - I**

**INTRODUCTION:** Automation and Robotics, CAD/CAM and Robotics, an over view of Robotics, present and future applications – classification by coordinate system and control system.

**COMPONENTS OF THE INDUSTRIAL ROBOTICS:** Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

**UNIT - II**

**MOTION ANALYSIS:** Homogeneous transformations as applicable to rotation and translation, problems.

**MANIPULATOR KINEMATICS:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics, problems.

**UNIT - III**

**MANIPULATOR DYNAMICS - I:** Differential transformation and manipulators, Jacobians, problems. Dynamics: Lagrange, Euler and Newton, Euler formations, Problems.

**MANIPULATOR DYNAMICS - II:** Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion, straight line motion, Robot programming, languages and software packages.

**UNIT - IV**

**ROBOT ACTUATORS AND FEEDBACK COMPONENTS:** Actuators: Pneumatic, Hydraulic actuators, electric and stepper motors. Feedback components: position sensors, potentiometers, resolvers, encoders, Velocity 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. M. P. Groover (2010), *Industrial Robotics*, 3<sup>rd</sup> edition, Pearson Education, New Delhi.
2. K.S. Fu (2010), *Robotics*, 1<sup>st</sup> edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

**REFERENCE BOOKS:**

1. R.K. Mittal, I. J. Nagrath (2012), *Robotics and Control*, 1<sup>st</sup> edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
2. P. Coiffet, M. Chaironze (2010), *An Introduction to Robot Technology*, 3<sup>rd</sup> edition, Kogam Page Ltd., London.
3. Richard D. Klafter(2010), *Robotic Engineering*, 2<sup>nd</sup> edition, Prentice Hall of India, New Delhi.

**COMPOSITE MATERIALS**  
(Professional Elective - I)

Course Code: A1338

L	T	P	C
3	1	-	4

**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, 3<sup>rd</sup> edition, Wiley WCH, West Germany.
2. K. K. Chawla (2010), *Composite Materials*, 2<sup>nd</sup> edition, Springer, USA.

**REFERENCE BOOKS:**

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



**UN CONVENTIONAL MACHINING PROCESSES**  
(Professional Elective - I)

Course Code: A1339

L T P C  
3 1 - 4

**UNIT - I**

**INTRODUCTION:** Need for non-traditional machining methods-Classification of modern machining processes, considerations in process selection, Materials, Applications.

**UNIT - II**

**ULTRASONIC MACHINING:** Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development. Abrasive jet machining, Water jet machining and abrasive water jet machine: Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

**UNIT - III**

**ELECTRO CHEMICAL PROCESSES:** Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process. Metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM, Simple problems for estimation of metal removal rate. Fundamentals of chemical, machining, advantages and applications.

**UNIT - IV**

**THERMAL METAL REMOVAL PROCESSES :** General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes, Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

**UNIT - V**

**GENERATION AND CONTROL OF ELECTRON BEAM FOR MACHINING:** Theory of electron beam machining, comparison of thermal and non-thermal processes, General Principle and application of laser beam machining - thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining, principle, maskants, etchants, applications.

**TEXT BOOKS:**

1. P. C. Pandey, H. S. Shah (2012), *Modern machining process*, 1<sup>st</sup> edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi, India.

**REFERENCE BOOKS:**

1. V. K. Jain (2008), *Advanced machining processes*, 3<sup>rd</sup> edition, Allied Publishers, New Delhi, India.
2. A. Bhattacharya(2009), *New Technology*, 2<sup>nd</sup> edition, the Institution of Engineers, India.

**LIST OF EXPERIMENTS :**

1. **DRAFTING:** Development of part drawings for various components in the form of orthographic and isometric. Representation of Dimensioning and tolerances scanning and plotting.
2. **PART MODELING:** Generation of various 3D Models through Protrusion, revolve, shell sweep Creation of various features. Study of parent child relation. Feature based and Boolean based modeling surface and Assembly Modeling. Study of various standard Translators, Design simple components.
3.
  - a. Determination of deflection and stresses in 2D and 3D trusses and beams.
  - b. Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.
  - c. Determination of stresses in 3D and shell structures (at least one example in each case)
  - d. Estimation of natural frequencies and mode shapes Harmonic response of 2D beam.
  - e. Steady state heat transfer Analysis of plane and Axisymmetric components.

**Any Four Software Packages from the following:**

Pro-E, I-DEAS, CATIA, UNIGRAPHICS, ANSYS, NISA, CAEFEM, CAM, AUTOCAD, etc.

**PART - A**

**PRODUCTION DRAWING:**

**UNIT - I**

Conventional representation of Materials, conventional representation of parts, screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits, methods of indicating notes on drawings.

**UNIT - II**

**LIMITS AND FITS:** Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.

**FORM AND POSITIONAL TOLERANCES:** Introduction and indication of the tolerances of form and position on drawings, deformation of runout and total runout and their indication.

**UNIT - III**

**SURFACE ROUGHNESS AND ITS INDICATION:** Definitions , finishes obtainable from various manufacturing processes, recommended surface roughness on mechanical components.

**UNIT - IV**

Heat treatment and surface treatment symbols used on drawings.

**UNIT - V**

**DETAILED AND PART DRAWINGS:** Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc.

Part drawing using computer aided drafting by CAD software

**TEXT BOOKS:**

1. K. L. Narayana, P. Kannaiah (2012), *Production and Drawing*, New Age International Publications, New Delhi, India.
2. Pohit, Ghosh, (2012), *Machine Drawing with Auto CAD*, Pearson Education, New Delhi, India.

**REFERENCE BOOKS:**

1. James D. Meadows (2008), *Geometric dimensioning and tolerance*, B.S Publications, Chennai, India.
2. R. K. Jain (2009), *Engineering Metrology*, Khanna Publications, New Delhi, India.

**PART - B**

**INSTRUMENTATION LAB**

**List of Experiments:**

1. Calibration of Pressure Gauges
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotometer for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.

# **SYLLABI FOR VIII SEMESTER**

**UNIT - I**

**INTRODUCTION:** Introduction to the Sources of Energy, Resources and Development of Power in India.

**STEAM POWER PLANT:** Plant Layout, Working of different Circuits, types of coals, Properties of coal, Fuel handling equipments, Ash handling systems.

**COMBUSTION PROCESS:** overfeed and under feed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, draught system, cyclone furnace, Dust collectors, cooling towers and heat rejection. Feed water treatment.

**UNIT - II**

**INTERNAL COMBUSTION ENGINE PLANT:** *Diesel Power Plant:* Introduction, IC Engines, types, construction, Plant layout with auxiliaries, fuel supply system, air starting equipment, lubrication and cooling system, super charging.

**GAS TURBINE PLANT:** Introduction, classification, construction Layout with auxiliaries, Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

**UNIT - III**

**HYDRO ELECTRIC POWER PLANT:** Water power, Hydrological cycle/ flow measurement, drainage area characteristics, Hydrographs, storage and Pondage, classification of dams and spill ways.

**HYDRO PROJECTS AND PLANT:** Classification, Typical layouts, plant auxiliaries, plant operation pumped storage plants.

**UNIT - IV**

**POWER FROM NON-CONVENTIONAL SOURCES:** Utilization of Solar, Collectors, Principle of Working, Wind Energy, types, HAWT, VAWT, Tidal Energy.

**NUCLEAR POWER STATION:** Nuclear fuel, breeding and fertile materials, Nuclear reactor, reactor operation.

**TYPES OF REACTORS:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding - radioactive waste disposal.

**UNIT - V**

**DIRECT ENERGY CONVERSION:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

**POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:** Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load durationcurve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises. Effluents from power plants and Impact on environment, pollutants and pollution standards, Methods of Pollution control.

**TEXT BOOKS:**

1. Rajput (2011), *A Text Book of Power Plant Engineering*, 4<sup>th</sup> edition, Laxmi Publications, New Delhi, India.
2. C. Elanchezian, L. Saravana Kumar, B. Vijaya Ramkanth (2007), *Power plant Engineering*, 1<sup>st</sup> edition, I.K International Publishing House, New Delhi, India.

**REFERENCE BOOKS:**

1. Arora and S. Domkundwar (2008), *A Course in Power Plant Engineering*, 5<sup>th</sup> edition, Dhanpat Rai & Co. Delhi.
2. P. K. Nag (2008), *Power Plant Engineering*, 3<sup>rd</sup> edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi.
3. G.D. Rai (2009), *An Introduction to Power Plant Technology*, 3<sup>rd</sup> edition, Khanna Publications, New Delhi.

**NANO TECHNOLOGY**  
**Professional Elective - II**  
**(Common to ME & ECE)**

Course Code: A1344

L T P C  
3 1 - 4

**UNIT - I**

**INTRODUCTION TO NANOTECHNOLOGY:** Importance of nano scale, Nanostructure types, electronic, magnetic, optical Properties of Nano materials, top-down and bottom- up approach to nanostructures.

**QUANTUM MECHANICAL PHENOMENON IN NANOSTRUCTURES:** Quantum confinement of electrons in semiconductor Nano structures, one dimensional confinement (Quantum wires), two dimensional confinements (Quantum Wells), three dimensional confinements (Quantum dots).

**UNIT - II**

**CARBON NANO STRUCTURES:** Carbon nano tubes (CNTs), Fullerenes, C60, C80 and C240 Nanostructures, Properties (mechanical, optical and electrical) and applications.

**UNIT - III**

**FABRICATION OF NANO MATERIALS:** Physical Methods: Inert gas condensation, Arc discharge, RF plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Molecular beam epitaxy, Chemical vapour deposition method.

**NANO SCALE CHARACTERIZATION TECHNIQUES:** Scanning probe techniques (AFM, STM, SEM, TEM), XRD

**UNIT - IV**

**NANO DEVICES AND NANO MEDICINE:** Lab on chip for bio-analysis, Core/shell Nano particles in drug delivery systems (site specific and targeted drug delivery), cancer treatment, and bone tissue treatment.

**UNIT - V**

**NANO AND MOLECULAR ELECTRONICS:** Resonant-Tunneling structures, single electron tunneling, Single Electron transistors, coulomb blockade, giant magneto resistance, tunneling magneto resistance.

**NANOLITHOGRAPHY AND NANO MANIPULATION:** E-beam lithography and SEM based nanolithography and nano manipulation, Ion beam lithography, oxidation and metallization, Mask and its application, Deep UV lithography, X-ray based lithography.

**TEXT BOOKS:**

1. Charles. P. Pode (2010), *Introduction to nanotechnology*, Reprint Edition, Springer, Germany.
2. Bharat Bhusan (2010), *Springer Handbook of Nanotechnology*, 3<sup>rd</sup> edition, Springer, Germany.

**REFERENCES BOOKS:**

1. Phani kumar (2012), *Principles of nanotechnology*, 3<sup>rd</sup> edition, Scitech publications, India.
2. Challa S, S. Kumar (2007), *Nanofabrication towards biomedical application: Techniques, tools, Application and Impact*, 1<sup>st</sup> edition, Wiley, VCH USA.
3. Hari Singh Nalwa (2011), *Encyclopedia of Nanotechnology*, American Scientific Publishers, USA.
4. S. Dutta (2009), *Electron Transport in Mesoscopic systems*, 8<sup>th</sup> Print, Cambridge University press, UK.

**PLANT ENGINEERING AND INDUSTRIAL SAFETY**  
(Professional Elective - II)

Course Code: A1345

L T P C  
3 1 - 4

**UNIT - I**

**INTRODUCTION:** Introduction to the Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. Steam power plant. Combustion process: Properties of coal , overfeed and underfeed fuel beds, travelling gate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

**UNIT - II**

**INTERNAL COMBUSTION ENGINE PLANT:** *Diesel Power Plant:* Introduction, IC Engines, types, construction, Plant layout with auxiliaries, fuel supply system, air starting equipment, lubrication and cooling system, super charging. *Gas Turbine Plant:* Introduction, classification, construction, Layout with auxiliaries, Principles of working of closed and open cycle gas turbines. Combined Cycle. Power Plants and comparison.

**UNIT - III**

**HYDRO ELECTRIC POWER PLANT:** Water power, Hydrological cycle/flow measurement, drainage area characteristics, Hydrographs, storage and Pondage, classification of dams and spill ways.

**HYDRO PROJECTS AND PLANT:** Classification, Typical layouts, plant auxiliaries, plant operation pumped storage plants.

**UNIT - IV**

**INTRODUCTION SAFETY ENGINEERING:** Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception.

**TOXICOLOGY:** How toxicants enter biological organisms, How toxicants are eliminated from biological organisms. Industrial Hygiene: Government regulations, Identification, Evaluation, Control.

**UNIT - V**

**FIRES AND EXPLOSIONS:** The fire triangle, Distinction between fire and explosions; Definitions, Flammability characteristics of liquids and vapors, MOC and inverting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions.

**DESIGNS TO PREVENT FIRES AND EXPLOSIONS:** Inverting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems. Introduction to Reliefs: Relief concepts, Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems.

**TEXT BOOKS:**

1. R. K. Rajput (2011), *A Text Book of Power Plant Engineering*, 4<sup>th</sup> edition, Laxmi Publications, New Delhi, India.
2. D. A. Crowl, J. F. Louvar (1990), *Chemical Process Safety (Fundamentals with applications)*, Prentice Hall of India, New Delhi, India.

**REFERENCE BOOKS:**

1. P. K. Nag (2008), *Power Plant Engineering*, 3<sup>rd</sup> edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi, India.
2. H. H. Fawcett, Westwood (2010), *Safety and Accident Prevention in Chemical Operations*, Wiley Publications, New York.

**COMPUTATIONAL FLUID DYNAMICS**  
(Professional Elective - II)

Course Code: **A1346**

L	T	P	C
3	1	-	4

**UNIT - I**

**INTRODUCTION:** Methods to solve a physical problem , Numerical Methods , Brief comparison between FDM, FEM & FVM ,Applied Numerical Methods. Solution of a system of simultaneous Linear Algebraic Equations, Iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices. Finite Difference Applications in Heat conduction and Convection , Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

**UNIT - II**

**FINITE DIFFERENCES:** Discretization, consistency, stability, and Fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

**UNIT - III**

**ERRORS AND STABILITY ANALYSIS:** introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

**REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER:** Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier , stokes equations.

**UNIT - IV**

**STEADY FLOW:** dimensions form of Momentum and Energy equations, Stokes equation, and conservative body force fields, stream function, Vorticity formulation, Boundary, layer theory, Buoyancy, Driven Convection and stability.

**UNIT - V**

**SIMPLE CFD TECHNIQUES:** viscous flows conservation form space marching, relocation techniques, viscous flows, conservation from space marching relocation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications.

**TEXT BOOKS:**

1. J Chung (2010), *Computational Fluid Dynamics*, 2<sup>nd</sup> edition, Cambridge University Press, India.
2. John .D. Anderson (2010), *Computational Fluid Dynamics*, 3<sup>rd</sup> edition, McGraw- Hill International Edition, India.

**REFERENCE BOOKS:**

1. Ronnie Anderson (2012), *Computational Fluid Dynamics for Engineers*, 2<sup>nd</sup> edition, Cambridge University Press, India.
2. Jean-Jacques Chattot (2010), *Computational aerodynamics and fluid dynamics an introduction*, 3<sup>rd</sup> edition, Springer, Germany.



**AUTOMATION IN MANUFACTURING**  
(Professional Elective - II)

Course Code: A1347

L	T	P	C
3	1	-	4

**UNIT - I**

**INTRODUCTION:** Types and strategies of automation, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automaton.

**AUTOMATED FLOW LINES:** Methods of work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

**UNIT - II**

**ANALYSIS OF AUTOMATED FLOW LINES:** General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

**UNIT - III**

**ASSEMBLY SYSTEM AND LINE BALANCING:** Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**AUTOMATED MATERIAL HANDLING:** Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

**UNIT - IV**

**ADAPTIVE CONTROL SYSTEMS:** Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission.

**UNIT - V**

**BUSINESS PROCESS RE-ENGINEERING:** Introduction to BPE logistics, ERP, Software configuration of BPE, concurrent Engineering, Techniques of Rapid Prototyping.

**TEXT BOOKS:**

1. M. P. Groover (2011), *Automation, Production Systems and Computer Integrated Manufacturing*, 3<sup>rd</sup> edition, Prentice Hall of India, New Delhi, India.
2. P. N. Rao (2011), *CAD/CAM Principles and applications*, 3<sup>rd</sup> edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi, India.

**REFERENCE BOOKS:**

1. Yoram Coreom (2011), *Computer control of Manufacturing Systems*, 2<sup>nd</sup> edition, Prentice Hall of India, New Delhi, India.
2. W. Buekinsham (2010), *Automation*, 3<sup>rd</sup> edition, Prentice Hall of India, New Delhi, India.

**RELIABILITY ENGINEERING**  
(Professional Elective - II)

Course Code: **A1348**

**L T P C**  
**3 1 - 4**

**UNIT - I**

**INTRODUCTION:** Definition, importance of reliability, introduction to probability distributions, exponential, Weibull, normal, lognormal, Gamma, bath tube cure, reliability and hazard functions, determination methods.

**UNIT - II**

**RELIABILITY ANALYSIS:** Factor of safety and reliability, reliability when S and L follow normal distribution, log normal distribution, fatigue design: deterministic design procedure, probabilistic design, procedure, reliability analysis of mechanical systems.

**UNIT - III**

**RELIABILITY TESTS:** Types, component reliability from test data, reliability models for series, parallel, stand by and k-out-of-m systems.

**UNIT - IV**

**RELIABILITY TECHNIQUES:** Reliability allocation, derating components, reliability prediction in industries, cut set /tie set, FTA, Markov models, Monte Carlo simulation.

**UNIT - V**

**RELIABILITY EVALUATION:** Significance of availability and maintainability concepts in reliability evaluation, importance of maintainability in design and manufacturing, reliability and associated costs, economics of reliability, Reliability management.

**TEXT BOOKS:**

1. S. S. Rao (2011), *Reliability based design*, 3<sup>rd</sup> edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi, India.
2. E. Balaguruswamy (2011), *Reliability Engineering*, 4<sup>th</sup> edition, Tata McGraw -Hill Publishing Company Ltd., New Delhi, India.

**REFERENCE BOOKS:**

1. A. D. S Carter (2009), *Mechanical Reliability*, 3<sup>rd</sup> edition, Macmillan, India.
2. L. S. Srinath (2010), *Concepts in reliability engineering*, 4<sup>th</sup> edition, Affiliated East West Press, India.

**NDT TECHNIQUES**  
(Professional Elective - II)

Course Code: A1349

L	T	P	C
3	1	-	4

**UNIT - I**

**INTRODUCTION:** *Visual Methods:* Optical aids, In-situ metallographic, Optical holographic methods, Dynamic inspection.

**UNIT - II**

**PENETRANT FLAW DETECTION:** Principles , Process, Penetrant systems , Liquid penetrant materials , Emulsifiers, cleaners developers , sensitivity , Advantages , Limitations, Applications.

**UNIT - III**

**RADIOGRAPHIC METHODS:** Limitations, Principles of radiography, sources of radiation, Ionizing radiation, X-rays sources, Gama-rays sources recording of radiation, Radiographic sensitivity, Fluoroscopic methods.

**ULTRASONIC TESTING OF MATERIALS:** Advantages, disadvantages, Applications, Generation of Ultrasonic waves, general characteristics of ultrasonic waves - methods and instruments for ultrasonic materials testing.

**UNIT - IV**

**MAGNETIC METHODS:** Advantages, Limitations, Methods of generating fields, magnetic particles and suspending liquids Magnetography, field sensitive probes, applications.

**ELECTRICAL METHODS:** Eddy current methods: potential-drop methods, applications.

**UNIT - V**

**ELECTROMAGNETIC TESTING:** Magnetism, Magnetic domains, Magnetization curves, Magnetic Hysteresis, Hysteresis-loop tests, comparator - bridge tests, Absolute single-coil system, applications.

**OTHER METHODS:** Acoustic Emission methods, Acoustic methods, Leak detection, Thermal inspection.

**TEXT BOOKS:**

1. Prasad (2011), *Non-Destructive Test and Evaluation of Materials*, 1<sup>st</sup> edition, Tata McGraw-Hill, New Delhi.
2. R. Halmshaw (1991), *Non-Destructive Testing*, 2<sup>nd</sup> edition, Edward Arnold, America.

**REFERENCE BOOKS:**

1. Jack Blitz (1997), *Electrical and Magnetic Methods of Non-Destructive Testing*, Springer, Germany.
2. Jack Blitz (1997), *Ultrasonic Methods of Non-Destructive Testing*, Springer, Germany.
3. Ravi Prakash (2009), *Non-destructive Testing Techniques*, 2nd Edition, New Academic Science Ltd., UK.

**CONCURRENT ENGINEERING**  
(Professional Elective - III)

Course Code: A1350

L	T	P	C
3	1	-	4

**UNIT - I**

**INTRODUCTION:** Extensive definition of CE, CE design methodologies ,organizing for CE, CE tool box collaborative product development

**USE OF INFORMATION TECHNOLOGY:** IT supports, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence, Expert systems, Software hardware co-design.

**UNIT - II**

**DESIGN STAGE:** Life-cycle design of products, opportunity for manufacturing enterprises, modality of Concurrent Engineering Design. Automated analysis idealization control, Concurrent engineering a optimal structural design, Real time constraints.

**UNIT - III**

**MANUFACTURING CONCEPTS AND ANALYSIS:** Manufacturing competitiveness, Checking the design process, conceptual design mechanisms, Qualitative, physical approach , An intelligent design for manufacturing system.

**JIT SYSTEM:** Low inventory, modular, Modeling and reasoning for computer based assembly planning, Design of Automated manufacturing.

**UNIT - IV**

**PROJECT MANAGEMENT:** Life Cycle semi realization, design for economics, and evaluation of design for manufacturing cost.

**UNIT - V**

**CONCURRENT MECHANICAL DESIGN:** Decomposition in concurrent design, negotiation in concurrent engineering design studies, product realization taxonomy, plan for Project Management on new product development , bottleneck technology development.

**TEXT BOOKS:**

1. Andrew Kuasik (2000), *Concurrent Engineering: Automation Tools and Technology*, Wiley John and Sons Inc., USA.
2. Anderson M. M. Hein, L. Berlin (2009), *Integrated Product Development*, 2<sup>nd</sup> edition, Springer, Verlag.

**REFERENCE BOOKS:**

1. Cleetus. J (1992), *Design for Concurrent Engineering*, *Concurrent Engineering Research Centre*, 4<sup>th</sup> edition, Morgantown, West Virginia.

**MECHANICAL VIBRATIONS**  
(Professional Elective - III)

Course Code: A1351

L T P C  
3 1 - 4

**UNIT - I**

**SINGLE DEGREE OF FREEDOM SYSTEMS - I:** *Undamped and damped free vibrations:* forced vibrations; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation; Vibration isolation and transmissibility.

**UNIT - II**

**SINGLE DEGREE OF FREEDOM SYSTEMS - II:** *Response to Non Periodic Excitations:* unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

**UNIT - III**

**TWO DEGREE FREEDOM SYSTEMS:** Principal modes, undamped and damped free and forced vibrations; undamped vibration absorbers;

**MULTI DEGREE FREEDOM SYSTEMS:** Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi-rotor systems and geared systems; Discrete-Time systems.

**UNIT - IV**

**NUMERICAL METHODS:** Rayleigh's, Stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

**CONTINUOUS SYSTEMS:** Free vibration of strings, longitudinal oscillations of bars, transverse vibrations of beams, Torsional vibrations of shafts.

**UNIT - V**

**CRITICAL SPEEDS OF SHAFTS:** Critical speeds without and with damping, secondary critical speed.

**VIBRATION MEASURING INSTRUMENTS:** Vibrometers, velocity meters and accelerometers

**TEXT BOOKS:**

1. G. K. Groover (2009), *Mechanical Vibrations*, 12<sup>th</sup> edition, Neel Chand & Bros, Roorkee, India.
2. S. S. Rao (2011), *Mechanical Vibrations*, 4<sup>th</sup> edition, Pearson, New Delhi, India.

**REFERENCE BOOKS:**

1. S. P. Timoshenko (2010), *Vibration problems in Engineering*, 4<sup>th</sup> edition, Wiley, New York.
2. V. Ram Murthy (2010), *Mechanical Vibrations*, 3<sup>th</sup> edition, Pearson Education, India.

**TOTAL QUALITY MANAGEMENT**  
(Professional Elective - III)

Course Code: A1352

L	T	P	C
3	1	-	4

**UNIT - I**

**TOTAL QUALITY MANAGEMENT (TQM):** Overview, History, Stages of Evolution, elements, definitions, continuous improvement, objectives, internal and external customers.

**UNIT - II**

**QUALITY STANDARDS:** Need of standardisation, Institutions, bodies of standardisation, ISO 9000 series, ISO 14000 series, other contemporary standards. Quality measurement systems (QMS), developing and implementing QMS, non conformance database.

**UNIT - III**

**PROBLEM SOLVING:** Problem Solving process , corrective action , order of precedence , system failure analysis approach , flow chart , fault tree analysis , failure mode assessment and assignment matrix , organizing failure mode analysis , pedigree analysis.

**UNIT - IV**

**QUALITY CIRCLES:** organization, focus team approach , statistical process control , process chart , Ishikawa diagram , preparing and using control charts. Quality Function Development (QFD), elements of QFD, bench marking, Taguchi Analysis, loss function, Taguchi design of experiments.

**UNIT - V**

**VALUE IMPROVEMENT ELEMENTS:** Value improvement assault , supplier teaming. Six sigma approach , application of six sigma approach to various industrial situations.

**TEXT BOOKS:**

1. L. S. Srinath (2011), *Reliability Engineering*, 4<sup>th</sup> edition, East-west press, India.
2. Dale H. Besterfield (2011), *Total Quality Management*, 3<sup>rd</sup> edition, Pearson Education, India.

**REFERECNE BOOKS:**

1. Howard Giltow (2010), *Quality Management*, 2<sup>nd</sup> edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.
2. Joseph, Susan Berk (2011), *Total Quality Management*, 2<sup>nd</sup> edition, Prentice Hall of India, India.

**NON CONVENTIONAL SOURCES OF ENERGY**  
(Professional Elective - III)

Course Code: A1353

L T P C  
3 1 - 4

**UNIT - I**

**PRINCIPLES OF SOLAR RADIATION:** Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT - II**

**SOLAR ENERGY STORAGE AND APPLICATIONS:** Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**WIND ENERGY:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**UNIT - III**

**BIO MASS:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

**GEOTHERMAL ENERGY:** Resources, types of wells, methods of harnessing the energy, potential in India.

**UNIT - IV**

**OCEAN ENERGY:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

**UNIT - V**

**DIRECT ENERGY CONVERSION:** Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

**TEXT BOOKS:**

1. G. D. Rai (2010), *Non-Conventional Energy Sources*, 2<sup>nd</sup> edition, Pearson, India.

**REFERENCE BOOKS:**

1. B. H. Khan (2012), *Non-Conventional Energy Resources*, 2<sup>nd</sup> edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, India.
2. S. Hasan Saeed, D. K. Sharma (2010), *Non-Conventional Energy Resources*, 1<sup>st</sup> edition, S. K. Kataria & Sons Publishers, India.

**TRIBOLOGY**  
(Professional Elective - III)

Course Code: A1354

L T P C  
3 1 - 4

**UNIT - I**

**STUDY OF VARIOUS PARAMETERS:** Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index, determination of viscosity, different viscometers used, Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

**UNIT - II**

**HYDRODYNAMIC THEORY OF LUBRICATION:** Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions, Effects of side leakage, Reynolds equation in three dimensions, Friction in sliding bearing, hydrodynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti-friction bearing.

**UNIT - III**

**FRICTION AND POWER LOSSES IN JOURNAL BEARINGS:** Calibration of friction loss, friction in concentric bearings, bearing modulus, Sommer-field number. Heat balance, practical consideration of journal bearing design considerations.

**UNIT - IV**

**AIR LUBRICATED BEARING:** Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings, Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

**UNIT - V**

**TYPES OF BEARING OIL PADS:** Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings, externally pressurized bearings.

**BEARING MATERIALS:** General requirements of bearing materials, types of bearing materials.

**TEXT BOOKS:**

1. Basu, Sen Gupta, Ahuja (2011), *Fundamentals of Tribology*, 3<sup>rd</sup> edition, Prentice Hall of India, India.
2. Sushil Kumar Srivatsava (2012), *Tribology in Industry*, 4<sup>th</sup> edition, S. Chand & Co, New Delhi, India.

**REFERENCE BOOKS:**

1. B. C. Majumdar (2012), *Tribology*, 2<sup>nd</sup> Edition, Prentice Hall of India, India.



**ADVANCED IC ENGINES**  
**(Professional Elective - III)**

Course Code: A1355

L T P C  
3 1 - 4

**UNIT - I**

**SPARK IGNITION ENGINES:** Air-fuel ratio requirements, Design of carburetor, fuel jet size and venture size, Stages of combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

**UNIT - II**

**COMPRESSION IGNITION ENGINES:** Stages of combustion-normal and abnormal combustion, Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging, Introduction to Thermodynamic Analysis of CI Engine Combustion process.

**UNIT - III**

**ENGINE EXHAUST EMISSION CONTROL:** Formation of NO<sub>x</sub>, HC/CO mechanism, Smoke and Particulate emissions, Green House Effect Methods of controlling emissions. Three way catalytic converter and Particulate Trap, Emission (HC, CO, NO and NO<sub>x</sub>) measuring equipments, Smoke and Particulate measurement, Indian Driving Cycles and emission norms.

**UNIT - IV**

**ALTERNATE FUELS FOR IC ENGINES:** Alcohols, Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications.

**CHARACTERISTICS OF IC ENGINES:** Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

**UNIT - V**

**RECENT TRENDS:** Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System, pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.

**TEXT BOOKS:**

1. Heinz Heisler (1998), *Advanced Engine Technology*, SAE International Publications, USA.
2. Ganesan V. (2007), *Internal Combustion Engines*, 3<sup>rd</sup> edition, Tata McGraw-Hill, India.

**REFERENCE BOOKS:**

1. John B. Heywood (1988), *Internal Combustion Engine Fundamentals*, Tata McGraw-Hill, New York.
2. Patterson D. J, Henein N. A (1978), *Emissions from combustion engines and their control*, Ann Arbor Science publishers Inc, USA.
3. Gupta H. N (2006), *Fundamentals of Internal Combustion Engines*, Prentice Hall of India, India.
4. Ulrich Adler (1995), *Automotive Electric / Electronic Systems*, Published by Robert Bosh, GmbH.

**B. Tech. ME VIII SEMESTER**

**CAM LAB**

Course Code: **A1356**

L	T	P	C
-	-	6	2

**LIST OF EXPERIMENTS:**

1. Manual part programming for CNC machines using standard G and M codes for a CNC LATHE
2. Part programming for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation, Combination of few operations on CNC lathe
3. Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands.
4. Part Programming uses Fixed or Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning, Thread cutting.
5. Simulation of Tool Path for different operations
6. Machining of small components using CNC LATHE & CNC MILLING MACHINE
7. Exposure to component modeling and CL data generation using CAM software.
8. Exposure to computer assisted part programming – APT or other NC programming language.

**SOFTWARE:** GIBBS CAM, MASTER

**Note:** Minimum 10 of the above experiments are to be conducted.

**1. OBJECTIVE:**

Seminar is an important component of learning in an Engineering College, where the student gets acquainted with preparing a report & presentation on a topic.

**2. PERIODICITY / FREQUENCY OF EVALUATION: Twice**

**3. PARAMETERS OF EVALUATION:**

1. The seminar shall have two components, one chosen by the student from the course-work without repetition and approved by the faculty supervisor. The other component is suggested by the supervisor and can be a reproduction of the concept in any standard research paper or an extension of concept from earlier course work.
2. The two components of the seminar are distributed between two halves of the semester and are evaluated for 50 marks each. The average of the two components shall be taken as the final score.
3. The students shall be required to submit the rough drafts of the seminar outputs within one week of the commencement of the class work.
4. Supervisor shall make suggestions for modification in the rough draft. The final draft shall be presented by the student within a week thereafter.
5. Presentation schedules will be prepared by different Departments in line with the academic calendar.

**The Seminars shall be evaluated in two stages as follows:**

**A. Rough draft**

In this stage, the student should collect information from various sources on the topic and collate them in a systematic manner. He/ She may take the help of the concerned supervisor.

The report should be typed in "MS-Word" file with "calibri" font, with font size of 16 for main heading, 14 for sub-headings and 11 for the body text. The contents should also be arranged in Power Point Presentation with relevant diagrams, pictures and illustrations. It should normally contain 18 to 25 slides, consisting of the followings:

1.	Topic, name of the student & guide	1 Slide
2.	List of contents	1 Slide
3.	Introduction	1 - 2 Slides
4.	Descriptions of the topic (point-wise)	7 - 10 Slides
5.	Images, circuits etc.	6 - 8 Slides
6.	Conclusion	1 - 2 Slides
7.	References/Bibliography	1 Slide

The soft copy of the rough draft of the seminar presentation in MS Power Point format along with the draft Report should be submitted to the concerned supervisor, with a copy to the concerned HOD within 30 days of the commencement of class work.

The evaluation of the Rough draft shall generally be based upon the following.

1.	Punctuality in submission of rough draft and discussion	2 Marks
2.	Resources from which the seminar have been based	2 Marks
3.	Report	3 Marks
4.	Lay out, and content of Presentation	3 Marks
5.	Depth of the students knowledge in the subject	5 Marks
Total		15 Marks

After evaluation of the first draft the supervisor shall suggest further reading, additional work and fine tuning, to improve the quality of the seminar work.

Within 7 days of the submission of the rough draft, the students are to submit the final draft incorporating the suggestions made by the supervisor.

**B. Presentation:**

After finalization of the final draft, the students shall be allotted dates for presentation (in the designated seminar classes) and they shall then present it in presence students, supervisor, faculties of the department and at least one faculty from some department / other department.

The student shall submit 3 copies of the Report neatly bound along with 2 soft copies of the PPT in DVD medium. The students shall also distribute the title and abstract of the seminar in hard copy to the audience. The final presentation has to be delivered with 18-25 slides.

The evaluation of the Presentation shall generally be based upon the following.

1.	Contents	10 Marks
2.	Delivery	10 Marks
3.	Relevance and interest the topic creates	5 Marks
4.	Ability to involve the spectators	5 Marks
5.	Question answer session	5 Marks
Total		35 Marks

**4. WHO WILL EVALUATE?**

The presentation of the seminar topics shall be made before an internal evaluation committee comprising the Head of the Department or his/her nominee, seminar supervisor and a senior faculty of the department / other department.

**1. OBJECTIVE:**

- To enable the examiners to assess the candidate's knowledge in his or her particular field of learning.
- To test the student's awareness of the latest developments and relate them to the knowledge acquired during the classroom teaching.

**2. PARAMETERS OF EVALUATION:**

<b>Subject Knowledge</b>	<b>Current Awareness</b>	<b>Career Orientation</b>	<b>Communication Skills</b>	<b>Total</b>
<b>20</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>50</b>

**3. WHO WILL EVALUATE?**

The comprehensive Viva will be conducted by a committee comprising Head of the Department or his/her nominee, two senior faculty of the respective department and an external examiner from outside the college. The comprehensive viva shall be evaluated for 50 marks at the end of VIII semester. A minimum of 40% of maximum marks shall be obtained to earn the corresponding credits.

**4. PERIODICITY / FREQUENCY OF EVALUATION:       Once****5. PEDAGOGY:**

- The viva will be held on a face to face basis.
- The students will be expected to answer the questions related to latest developments and all courses taken till date.
- Viva voce will be conducted within week before the beginning of midterm examinations. However, in exceptional circumstances it can be scheduled immediately after the end of midterm examinations.
- Students will have to make themselves available on the date of the viva voce.

**1. OBJECTIVE:**

The main objective of the Project Work is for the students to learn and experience all the major phases and processes involved in solving “real life engineering problems”.

**2. EXPECTED OUTCOME:**

The major outcome of the B. Tech project must be well-trained students. More specifically students must have acquired:

- System integration skills
- Documentation skills
- Project management skills
- Problem solving skills

**3. PROJECT SELECTION:**

Projects are suggested by the faculty, with or without collaboration with an industry. All faculty are to suggest projects. Students are also encouraged to give project proposals after identifying a faculty who would be willing to supervise the work. A Project brief is to be given by the faculty to the group defining the project comprehensively.

All B. Tech major projects are to be done in the Institute. For industry specified projects, students will be permitted to spend 1-2 weeks in the industry on recommendation by the supervisor. The number of students per batch should be between 2 and 4. If more number of students is really needed, the project may be split into functional modules and given to subgroups.

**4. WHO WILL EVALUATE?**

The end semester examination shall be based on the report submitted and a viva-voce exam for 150 marks by committee comprising of the Head of the Department, project supervisor and an external examiner.

**5. EVALUATION:**

The basic purpose is to assess the student competencies with regard to his project work. More specifically to assess the student’s individual contribution to the project, to establish the level of understanding of basic theoretical knowledge relevant to the project and to ensure that the student has good understanding and appreciation of design and development decisions taken in the course of the project. It is desirable that all faculty members are present for the evaluations as this is a platform to get to know the student projects and to motivate the students to do good projects. The faculty should adopt a clear and consistent pattern of asking questions from general to specific aspects of the project. The presentation and evaluation is open to other students of the department.

The project work shall be evaluated for 200 marks out of which 50 marks for internal evaluation and 150 marks for end-semester evaluation. The evaluation shall be done on the following basis

Semester VII	Semester VIII
Preliminary Evaluation - 10 marks	Design Evaluation II - 25 marks
Design Evaluation I - 15 marks	Final Evaluation – 150 marks

**6. GUIDELINES FOR THE PREPARATION OF B. TECH PROJECT REPORTS**

- 1.1. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on a A4 size bond paper (210 x 297 mm). The margins should be: Left - 1.25", Right - 1", Top and Bottom - 0.75".
- 1.2. The total number of reports to be prepared are:
  - One copy to the department
  - One copy to the concerned guide(s)
  - One copy to the candidate.
- 1.3. Before taking the final printout, the approval of the concerned guide(s) is mandatory and suggested corrections, if any, must be incorporated.
- 1.4. For making copies dry tone Xerox is suggested.
- 1.5. Every copy of the report must contain
  - Inner title page (White)
  - Outer title page with a plastic cover
  - Certificate in the format enclosed both from the college and the organization where the project is carried out.
  - An abstract (synopsis) not exceeding 100 words, indicating salient features of the work.

6.6. The organization of the report should be as follows:

1.	Inner title page	Usually numbered in roman
2.	Abstract or Synopsis	
3.	Acknowledgments	
4.	Table of Contents	
5.	List of table & figures (optional)	

- 6.7. Chapters (to be numbered) containing Introduction, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.
  - The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.
  - The report should be typed in "MS-Word" file with "calibri" font. The chapter must be left or right justified (font size 16). Followed by the title of chapter centered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 11.
  - The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.
  - The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
- 6.8. **Reference OR Bibliography:** The references should be **numbered serially** in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.
  - 1. For textbooks - A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.
  - 2. For papers - Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.
- 6.9. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.  $V = IZ$  ..... **(3.2)**
- 6.10. All equation numbers should be right justified.

- 6.11. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.
- 6.12. Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project
- 6.13. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
- 6.14. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.
- 6.15. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same duly attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.
- 6.16. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
- 6.17. Separator sheets, used if any, between chapters, should be of thin paper

## **VARDHAMAN COLLEGE OF ENGINEERING**

(Autonomous)

Shamshabad – 501 218, Hyderabad

Department of .....

### **CERTIFICATE**

Certified that the project work entitled ..... carried out by Mr./Ms. ...., Roll Number ....., a bonafide student of .....in partial fulfillment for the award of **Bachelor of Technology** in ..... of the Jawaharlal Nehru Technological University, Hyderabad during the year ..... It is certified that all corrections / suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

**Name & Signature of the Guide**

**Name Signature of the HOD**

**Signature of the Principal**

### External Viva

Name of the examiners

Signature with date

- 1.
- 2.



## Certificate issued at the Organization where the project was carried out

(On a separate sheet, If applicable)

NAME OF THE INDUSTRY / ORGANIZATION, Address with pin code

### CERTIFICATE

Certified that the project work entitled ..... carried out by  
Mr./Ms . . . . ., Roll Number....., a bonafide student of  
.....in partial fulfillment for the award of **Bachelor of Technology** in  
..... of the Jawaharlal Nehru Technological University, Hyderabad  
during the year ..... It is certified that, he/she has completed the project satisfactorily

Name & Signature of the Guide

Name & Signature of the Head of Organization

### 7. DISTRIBUTION OF MARKS FOR B.TECH DISSERTATION EVALUATION

S No.	Particulars	Max. Marks
1	Relevance of the subject in the present context	10
2	Literature Survey	10
3	Problem formulation	20
4	Experimental observation / theoretical modeling	10
5	Results – Presentation & Discussion	20
6	Conclusions and scope for future work	10
7	Overall presentation of the Thesis / Oral presentation	40
8	Project Report Writing	30
<b>Total Marks</b>		<b>150</b>