

Third Semester

PE - 14301 Strength of Materials

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course Objectives(C Obj.): At the end of the course, the student should understand

1. The fundamental modes of loading of the structures
2. Measurements of loads, displacements and strains.
3. This course will help in designing all types of structures and machines.
4. Develop or enhance a background in materials and processes, which can be carried to other courses, later research, and employment in manufacturing and design.

Course Outcomes (CO): This course used assigned readings, lectures, and homework to enable the student to:

1. Perform tensile and compression test
2. Knowledge of Bending test on Beam
3. Perform torsion test and impact test
4. Calculation of buckling load in long column

Detailed Contents

Unit I

Simple stresses and strains : Concept of stress and strain; St. Venant's principle, stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stress and strains in bars subjected to axial loading. Modulus of elasticity, stress produced in compound bars subject to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound bars. Compound stress and strains, the two dimensional system; stress at a point on a plane, principal stresses and principal planes; Mohr's circle of stress; ellipse of stress and their applications. Generalized Hook's Law, principal stresses related to principal strains, Concept of strain energy and introduction of theories of failure.

Unit II

Bending moment and shear force diagrams: S.F and B.M definitions. BM and SF diagrams for cantilevers, simply supported beams with or without overhangs and calculation of maximum BM and SF and the point of contraflexure under the following loads:

- i) Concentrated loads
- ii) Uniformity distributed loads over the whole span or part of span
- iii) Combination of concentrated loads (two or three) and uniformly distributed loads
- iv) Uniformity varying loads
- v) Application of moments Relation between rate of loading, shear force and bending moment

Unit III

Theory of bending: stresses in beams due to bending, assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular channel, I and T-sections; Combined direct and bending stresses in aforementioned section, composite / flitched beams.

Unit IV

Torsion : Derivation of torsion equation and its assumptions. Applications of the equation to the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts principal stress and maximum shear stresses under combined loading of bending and torsion.

Unit V

Thin cylinders and spheres : Derivation of formulae and calculation of hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume; principal stresses in sphere and change in diameter and internal volume

Unit VI

Columns and struts : Columns and failure of columns : Euler's formulas; Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications.

Unit VII

Slope and deflection : Relationship between moment, slope and deflection, Moment areamethod of integration; Macaulay's method: Use of all these methods to calculate slope and deflection for the following :

- a. Cantilevers
- b. Simply supported beams with or without overhang
- c. Under concentrated loads, uniformly distributed loads or combination of concentrated and uniformly distributed loads

Books Recommended

1. Mechanics of Materials-SI Version 2nd Edition by EP Popov, (Prentice Hall India)
2. Introduction to Solid Mechanics by D.H Shames, (Prentice Hall Inc.)
3. Strength of Materials by Dr.D.S. Bedi; (S Chand Publishers)
4. Strength of Materials by R.S.Lehri and A.S. Lehri, (S.K Kataria and Sons.)
5. Strength of Materials by Dr.Sadhu Singh (Khanna Publishers)
6. Strength of Materials by R.S.Khurmi (S.Chand& Co.)

PE - 14302 Machine Drawing

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
206

Course Objectives(C Obj.):- The course has been designed for following objectives:

1. Understanding the principles and requirements of production drawings and various symbols used in drawing.
2. How to assemble and disassemble the various couplings, pipe fittings, boiler mountings, bearing, machine tool parts, screw jack, and drill press.
3. To enable students to draw various machine tools and produce their material bills.
4. Knowledge about selecting the manufacturing process to produce the component.

Course Outcomes (CO): -

1. The course studied enables the students to read, draw and interpret the entities being drawn in the course.
2. The knowledge gained streamlined the drafting skills of the students.
3. The course studied enables the student for drafting a new component in industrial applications.
4. The studied course increases the ability to suggest the required manufacturing process and methods for material saving.

Detailed Contents

Unit I

Principles of drawing, requirements of production drawings, symbols of standard tolerances, machining symbols, sectioning and conventional representation, dimensioning, welding symbols, Rivets & Riveted joint, various types of screw threads.

1. Assembly and Dis- assembly of the following manually and using computer aided drafting.

- a) Couplings: Pin type, flexible coupling, claw coupling, cone friction clutch, single plate friction clutch.
- b) Pipe and pipe fittings.
- c) IC Engine Parts: Piston, connecting rod, Cross head and eccentric
- d) Bearings: Swivel bearing, thrust bearing, Plummer block
- e) Machine tool parts: lathe tail stock, tool post.
- f) Miscellaneous: Screw jack, drill press vice.

2. Drafting of simple Mechanical components on computer.

NOTE: First angle projection to be used. Drawings should contain bill of materials and should illustrate surface finish. The syllabus given above indicates the broad outlines and the scope of the subject to be covered. It is not necessary to cover all the drawing exercises of the types of machine tools mentioned above.

Recommended Books:

1. Machine Drawing by PS Gill, (Kataria & Sons.)
2. Machine Drawing by ND Bhatt, (Charotar)
3. Machine Drawing by N. Sidheswar, (Tata McGraw Hill)
4. Textbook of Machine Drawing by K.C. John (PHI Learning)

PE - 14303 Thermal Engineering

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course Objectives (C Obj.):- This course is designed for Production Engineering students for comprehensive study of steam power plants, its allied components and reciprocating compression machines. The various objectives of this course are as follows:

1. To understand and recognize the various components of steam power plants.
2. To provide knowledge about different types of steam boilers / generators, boiler mountings and accessories and methods for improving boiler performance.
3. To enable the students to understand combustion phenomenon.
4. Comprehensive thermal analysis of simple and modified Rankin cycle.

Course outcomes (CO):

1. Students are able to identify, track and solve various combustion problems.
2. Students are able to recognize and understand the working of devices involved in steam power generation system.
3. Students are able to evaluate theoretically the performance of various components involved in steam power plants and reciprocating compression machines.
4. Students are able to design some components of steam power plants and reciprocating compression machines.

Detailed Contents

Unit I

Heat Transfer: Modes of Heat Transfer–Conduction, Convection and Radiation. Steady and unsteady heat transfer, Fourier law of conduction and thermal conductivity, Conduction of heat through a slab, through a hollow cylinder and through a hollow sphere, Natural and forced convection, convective heat transfer coefficient, Combined conduction and convective heat transfer, Critical thickness of insulation, Fin and its application, Types of fins, Analysis of heat transfer through a rectangular fin, Introduction to radiation, total emissive power, monochromatic emissive power, emissivity, Absorptivity, reflectivity and transmissivity, Black body, Opaque Body, Whitebody and Gray body, Stefan Boltzmann's Law, Kirchhoff's law, Plank's law, Wien's displacement law, Intensity of radiation and Lambert's cosine law. Heat Exchangers: Introduction, classification of heat exchanger, Heat exchanger analysis – Logarithmic mean temperature difference (LMTD) for parallel flow and counter flow.

Unit II

I.C Engines & Gas Turbines: Classifications of I.C. engines Working of two and four stroke petrol and diesel engines. Measurement of BHP, IHP, mechanical and thermal efficiency, Specific fuel consumption. Elementary idea of combustion phenomenon in S.I. and C.I. engines. Description of simple carburetor, fuel pump and injector. Magneto and battery ignition system. Simple Brayton Cycle, Description of open cycle Gas turbines, comparison of I.C. Engines and gas turbines, Steam turbine comparison of I.C. Engines, Gas Turbine and Steam Turbine with their applications.

Unit III

Refrigeration and Air Conditioning: Description of simple Vapour compression and Vapor absorption cycles, relative merits and demerits, Properties of refrigerants, Types & Application of Air Conditioning, Elementary idea of ozone friendly refrigerants, Concept of Psychrometry, Definitions of psychrometric terms i.e. dry air, moist air and saturated air, absolute humidity, relative humidity ratio or specific humidity, degree of saturation, Dew point temperature, Dry bulb temperature and wet bulb temperature. Psychrometric charts.

Unit IV

Boilers: Fire tube and water tube boilers, Description of Lancashire, Cochran, Locomotive, Babcock-Wilcox Boiler, mountings and accessories.

Unit V

Non-Conventional Power Generation: Introduction, advantages of non conventional energy sources, Wind power plants – multiple blade type, savonius type and darrieus type, Wind electric generation power plant – horizontal and vertical axis wind machines. Tidal power plant – classification and operation, single basin and double basin, Solar power plants – flat plate collector, concentrating collector, solar pond, Geothermal power plants. Biogas plants.

Recommended Books:

1. Thermal Engg. by V.P. Vasandani and D.S. Kumar, (Treatise on Heat Engineering Metropolitan)
2. Fundamentals of Engg. Thermodynamics by John R. Howell & Richard O Buckius (McGraw Hill International.)
3. Refrigeration & Air Condition by C.P. Arora (Tata McGraw Hill)
4. Thermal Engineering by Domkundwar (Dhanpat Rai & Co.)
5. Thermal Engineering by R. K. Rajput (S.Chand & Co.)
6. Non-Conventional energy sources by G.D. Rai, (Khanna Publishers)
7. Thermal fluid Sciences by Yunus A Cengel (Tata McGraw Hill)

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
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Course Objectives (C Obj.)The subject of theory of machines deals with various aspects of parts of different machines. The course shall enable students to:-

1. Understand the principles and fundamentals of static as well as dynamic parts.
2. Provide mathematical formulae to ensure the feasibility of various parts of machines and structures.
3. Introduction of different types of steering mechanisms.
4. Provide technical aspects for the application of different parts in industry.

Course Outcomes (CO):-At the end of the course, the students are able to:-

1. Understand the working of various primitive components of a machine.
2. Develop mathematical skills for the computation of industry related problems.
3. Determine the various physical parameters of power transmission devices, friction devices and different governing devices.
4. Compute the essential parameters like fluctuation of speed and energy in a flywheel of a vehicle, slotting machine etc.

Detailed Contents

Unit I

Basic concept of machines: Link, mechanism, kinematic pair and chain, principles of inversion, inversion of a four bar chain, slider- crank-chain, double slider crank chain and their inversions, kinematic pairs and analytical /geometrical methods for finding displacement velocity and acceleration of all basic mechanisms.

Unit II

Flywheels: Turning moment and crank effort diagrams for reciprocating machines Fluctuation of speed, coefficient of fluctuation of speed and energy, Determination of flywheel effect. Governors and types of governors.

Unit III

Belts, Ropes and chains: material types of drives, idler pulley, intermediate or counter shaft pulley, angledrive, quarter turn drive, velocity ratio, crowning of pulleys, loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack sides of belts. HP transmitted by belts including consideration of creep and slip, centrifugal tensions and its effect on HP transmitted. Flat, V-belts and rope materials. Length of belt, rope and chain drives.

Unit IV

Brakes, Dynamometers and Clutches: Types of brakes, principle, function of brakes of various types. Problems to determine braking capacity, types of dynamometer: absorption, transmission and driving. Function of Clutches. Disc and Cone clutches.

Unit V

Cams: Types of cams and followers, definitions of terms connected with cams, displacement, velocity and acceleration diagrams for cam followers, various motions: SHM, uniform acceleration and retardation, analysis of follower motion for circular, concave, tangent cam profiles.

Unit VI

Gears & Gear Trains: Toothed gears and spur gears, types of toothed gears, definitions: pitch circle diameter, pitch surface, pitch point, circular pitch, module, pitch, diametrical pitch, addendum, dedendum, clearance, outside and internal diameters, root diameter, base circle diameter, face and flank of tooth, pressure angle, path of contact, arc of contact, conditions for correct gearing, forms of teeth, involute and its variants, interference and methods of its removal. Types of gear trains, simple, compound and epicyclic gear trains, problems involving their applications, estimation of velocity ratio of worm and worm wheel, helical and spiral gears.

Books Recommended:

1. Theory of Machines by PL Ballaney, (Khanna Publishers)
2. Theory of Machines by Shigley, (McGraw Hill)
3. Theory of Machines by R.S.Khurmi, (S.Chand and Sons)
4. Theory of Machines by Thomas Bevan(PearsonsPublishiers)
5. Theory of Machines by S.S Ratan (McGraw Hill)

Internal Marks: 40**LTP****External Marks: 60****400****Total Marks: 100****Course Objectives (C Obj.):** The subject enables the students to understand the:

1. Fundamentals of casting and welding processes.
2. Essentials components of casting and welding processes.
3. Procedure or methodologies for conducting the casting and welding processes.

Handling of castings and welds

Course outcomes (CO):

1. The subject makes the students aware of fundamental principles about casting and welding processes so as to apply these principles for studying the processes.
2. Students are able to identify various equipments and accessories required for performing the casting and welding processes.
3. Students are able to demonstrate and guide the technicians for successful conduct of casting and welding processes in industrial applications.
4. The subjects are able to create the ability to test the products made by casting and welding processes so as to appreciate their utility in industrial applications.

Detailed Contents**Unit –I****Introduction:** Classification of manufacturing processes, Material properties, Selection criteria of manufacturing processes.**Casting:** Introduction to metal casting, types of patterns, their materials and allowances. Moulding materials, moulding sand compositions & moulding sand properties, sand testing; types of moulds, moulding Machines. Cores: core sands, types of cores, core baking. Elements of Gating systems and Risers and their design. Cupola and its operation, charge calculations, types of furnaces. Casting processes: sand casting, shell mould casting, investment casting, permanent mould casting, full mould casting, vacuum casting, Die-casting, Centrifugal casting, continuous casting Casting defects, their causes and remedies. Metallurgical considerations in casting, solidification of metals and alloys, directional solidification, segregation, nucleation and grain growth, critical size of nucleus. Casting of non ferrous metals and their alloys viz. aluminum and copper. Cleaning and finishing of castings, Testing and Inspection of castings**Unit –II****Welding:** Introduction and classification of welding processes, welding terms (terminology), general principles, welding positions, joint design and filler metals. Gas welding and Gas cutting: Principle, Oxyacetylene welding equipment. Oxy hydrogen welding, Flame cutting. Electric arc welding: Principle, equipments, types-MIG, TIG, submerged arc and others, Welding electrodes, classification and selection of electrodes, welding arc and its characteristics, arc stability, arc blow, mechanism of metal transfer, metallurgical effects of welding, solidification and gas absorption. Thermal effects on weldment. Heat affected zone. Grain size and its control. Resistance welding- principle and their types i.e. spot, seam, projection, upset and flash. Thermit welding, electro slag welding, friction welding, plasma arc welding, electron beam welding, laser beam welding, atomic hydrogen welding. Welding Defects, their causes and remedies. Brazing, braze welding, and soldering.**Books Recommended:**

1. Principles of Metal Casting by Heine, R.W. C.R. Loper and P.C. Rosenthal, (McGrawHill, New York).
2. Welding Technology by R.S. Parmar, (Khanna Publishers).
3. Workshop Technology Vol.1 by B.S. Raghuwanshi (Dhanpat Rai & Co.)
4. Welding and Welding Technology by Little (McGraw-Hill Education (India) Pvt Ltd).
5. Foundry Technology by O.P. Khanna ((Dhanpat Rai & Co.)

PE - 14306 Strength of Materials Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on C.I. and to determine ultimate compressive strength.
3. To perform shear test on different materials and determine ultimate shear strength.
4. To perform any one hardness test (Rockwell, Brinell & Vicker's test) and determine hardness of materials.
5. To perform impact test to determine impact strength.
6. To perform torsion test and to determine various mechanical properties.
7. Study of performance of Fatigue & Creep tests.
8. To perform bending test on beam (wooden or any other material) and to determine the Young's modulus and Modulus of rupture.
9. To perform Torsion test and close coiled helical spring in tension and compression and to determine modulus of rigidity/stiffness.
10. Determination of Bucking loads of long columns with different end conditions.

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
0 0 2

1. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept along the direction of flow.
2. Determination heat transfer coefficient of radiation and hence find the Stefan Boltzman's constant using two plates/two cylinders of same size by making one of the plates/cylinders as a black body.
3. Trial of single Cylinder, four stroke diesel engine to calculate BHP, IHP, and air fuel ratio thermal efficiency.
4. Morse test on multi cylinder petrol engine.
5. To find C.O.P of domestic refrigerator.
6. To find COP of an Air conditioner.
7. To find COP of water cooler.
8. Study of various types of boilers Models.

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

1. Study of working principles and construction of the different types of link motions and mechanisms.
2. Study of different types of gears and gear trains.
3. Study of different types of brakes and clutches.
4. Study of various types of quick return mechanisms and determination of quick return effects.
5. To study various types of cams and followers and the working, construction of a cylindrical cam for doing operation.
6. To study the flywheel and draw turning moment and crank effort diagram for a four stroke, single cylinder petrol and diesel engines.
7. Study various types of belts and calculate the length of belt and power transmitted by the flat and V-belts.
8. Study of various types of dynamometers and calculate the forces on a multi cylinder petrol engine.

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

Casting

1. To determine clay content and moisture content in a moulding sand sample.
2. To find shatter index of different sand samples and to compare and discuss the results
3. To test tensile, compressive, transverse strength and hardness a moulding sand in dry/wet conditions.
4. Determination of permeability of a moulding sand sample.
5. Measurement of grain fineness number.
6. To conduct a comparative study of various types of modern furnaces used in foundry industry.
7. To make detailed calculations for design of riser and gate for a given component and perform its casting

Welding

1. Specimen preparation and making of lap joint, butt joint. T-joint with Oxyacetylene gas welding.
2. Making of lap, Butt, T-joints etc. with electric arc welding.
3. Study of MIG welding equipment and making a weld joint by this process.
4. Study of TIG welding equipment and making a weld joint by this process.
5. Study of different process parameters in Friction welding and preparing a weld joint by this process.
6. To study various welding equipments namely rectifiers, generators, welding torch etc.
7. To study the resistance welding processes and prepare a spot-welded joint.

Note: It is essential for each student to visit at least one Foundry and one Welding industry and submit a detailed industrial tour report

Fourth Semester

PE - 14401 Design of Machine Elements

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): The main objective of the course is to design concepts of different machine elements. The aim of this course is:-

1. Application of scientific principles from various fields of engineering to create new technical feats, which can perform specific functions with maximum economy.
2. To help students in identifying various kinds of loading conditions and corresponding stresses in various machine elements.
3. To guide the students in designing a product from the conceptual stage to the final finished form in shortest possible time.
4. To make them understand the concepts in designing of permanent and temporary fasteners.

Course outcomes (CO): After the completion of this course the students are able to -

1. To understand the design flow chart for existing and new conceptual design.
2. Deal with the machine design problems in technical way using design principles and procedures.
3. Understand different stresses and strains (loading conditions), and also effect of these stresses and strains on different machine members.
4. To deal with problems of designing various types of joints and other important machine elements in a technical way.

Detailed Contents

Unit –I

Scope and meaning of machine design. Sources of design data. Design considerations from economics, manufacturing, aesthetics and ergonomics aspects. Design Process, Selection of Materials.

Unit –II

Screwed Joints: - Design of Bolted joints, Bolted Joints under eccentric Loading. **Welded Joints:** -Design of Fillet Welded Joints, Butt Joints, Un-symmetric Welded sections, Eccentrically loaded welded joints.

Unit –III

Riveted Joints: - Design of Lap Joints, Butt Joints, Diamond Riveting, Eccentrically loaded riveted joints.

Unit –IV

Design of Cotter and Knuckle Joints

Unit –V

Shafts: - Design of shafts under different types of loading conditions.

Unit –VI

Keys & Couplings: - Design of rectangular and square keys, muff coupling, split muff coupling, flange coupling, bushed-pin flexible coupling.

Unit –VII

Levers: - Design of straight levers, Bell -Crank levers, foot levers, hand levers.

Unit –VIII

Brakes and Clutches: - Design of friction plate and cone clutches, and simple type brakes.

Unit –IX

Introduction to Design for Manufacturing and Assembly

Books Recommended:

1. Mechanical Engineering Design by J.E. Shigley (McGraw-Hill Education (India) Pvt Ltd).
2. Machine Design by Dr. Sadhu Singh (Khanna Publishers)
3. A text book of machine design by R.S.Khurmi&J.K.Gupta, (S Chand & Co.)
4. Machine Design by D.K.Aggarwal&P.C.Sharma (S.K Kataria and Sons)
5. Design and Manufacturing by Krishnamurthi, (S.K. Kataria and Sons)

NOTE: Design data book is NOT allowed in the examination.

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): This subject helps in introducing the fluids and their properties to the students. The aim of the course is

1. To guide the students in studying kinematics and dynamics involved during fluid flow are studied in this course
2. To understand the dimensional analysis this is an important aspect for checking the dimensional homogeneity with the help of different methods
3. To enhance the knowledge of the student in developing the skills required for working upon the operating conditions of these turbines and pumps.

Course outcomes (CO):

After the completion of this course the students are able to know

1. How to solve problems relating to kinematic and dynamics of fluid flow.
2. How to analyze the fluid dynamic conditions and in assessing the equations involved on the basis of dimensional homogeneity
3. The various problems arising in turbines and pumps.

Detailed Contents

Unit I

Fluids & Their Properties: Concept of fluid; Ideal & Real fluids; significance of fluid Mechanics; continuity concept of fluid; density, specific weight, viscosity & its dependence on temperature; vapor pressure & cavitations; compressibility & bulk modulus, Newtonian & non Newtonian fluids.

Unit II

Fluid statics, kinematics & dynamics: Concept of pressure, Pascal's Law, Buoyancy & floatation, stability of floating & submerged bodies. Classification of fluid flows; streamline, path line & streakline; continuity equation in Cartesian coordinates. Euler's equation; Bernoulli's Equation & steady flow energy equation, Impulse momentum equation.

Unit III

Dimensional Analysis: Fundamental & derived units & dimensions; dimensional homogeneity; Rayleigh's & Buckingham's Pi method for dimensional Analysis. Model studies, Dimensionless numbers & their significance.

Unit IV

Laminar & Turbulent flows & their measurements: -Flow in circular cross section pipes; Turbulent & flow losses in pipes; Darcy Equation. -Manometers; pitot tubes; venture meter & Orificemeter; rotameter.

Unit V

Fluid machinery concepts: Impulse momentum principle; Jet impingement on stationary & moving flat plates and on stationary or moving vanes with jet striking at center & tangentially at one end of vane, calculations for force exerted, work done & efficiency of jet.

Unit VI

Turbines: Components parts & operation of Pelton, Francis & Kaplan Turbines Draft Tube- Its function & types (No Numerical).

Unit VII

Pumps : Component parts & operation of centrifugal & Reciprocating pumps: Suction, delivery & manometric heads of centrifugal pumps; priming & priming devices. Multistage pumps, series & parallel arrangements. Pressure variation due to piston acceleration & acceleration effects & air vessel

Books Recommended:

1. Fluid Mechanics & fluid power Engg. By D.S. Kumar (Metropolitan Publishers)
2. Fluid Mechanics by R.K. Bansal, (Laxmi Publications)
3. Fluid Mechanics by Potter & Wiggert (Cengage Learning)
4. Fluid Mechanics by A.K Mohanty (PHI Learning Pvt.Ltd.)
5. Fluid Mechanics and Hydraulic Machines by R.K. Rajput (Khanna Publishers)
6. Fluid Mechanics and Machinery by C.S.P. Ojha (Oxford University)

PE - 14403 Manufacturing Processes-II

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): This course has been designed for providing basic knowledge of machine tools. The aim of the course is

1. To make the students aware of principles and requirements for comprehensive understanding of metal cutting or machining.
2. To make students aware of the existing technologies related to the process with the aim of appreciating their industrial applications.
3. To make the students aware of the Machines Tools those are used in Industries for manufacturing.

Course outcomes (CO): After the completion of this course the students are able:-

1. To completely understand the machining process
2. To understand the various process parameters involved in different processes.
3. To apply this knowledge for practical use and application of manufacturing processes in the industries.

Detailed Contents

Unit I

Lathe Machine & its operations: Lathe & its accessories, Lathe specifications, Lathe cutting tools, speed, feed, depth of cut & machining time, various operations on Lathe (turning, facing, copy turning, boring, counter boring, parting off, chamfering, threading, chamfering etc.), Attachments used on Lathe; Turret & Capstan Lathe, Tool holding devices. Detailed calculations and numerical related to material removal rate, surface finish and tool wear for turning operations

Unit II

Milling Machines & its operations:

Milling machines (Horizontal, Vertical & Universal milling machine), specifications, accessories, standard & Special attachments (Vertical milling attachment, High speed milling attachment, Slotting attachment, Universal dividing head, Angular milling attachment); milling operations; Indexing, Type of indexing (Direct, Simple, Compound, Differential, Angular); milling cutters, size, shape & material of milling cutters; numerical related to cutting speed, feed, depth of cut & machining time.

Unit III

Shapers, Planer and Slotting machine:

Types of Shaper, Planers & Slotters and its operations, specifications; quick return mechanisms (crank & slot, hydraulic) shaper tools; calculations of cutting speed, feed and machining time.

Unit IV

Press Working: Definition, Various types of presses, feeding mechanisms, Various operations (Blanking, Piercing, Perforating, Shearing, Lancing, Drawing, Coining, Embossing, Stamping, Notching etc.); Various types of dies (Simple, Compound, Combination, Progressive, Transfer, Rubber die).

Unit V

Drilling Machines & Operations: Types of drilling machines, specifications, Drilling operations(drilling, counter sinking, spot facing, reaming, tapping etc); Multi-spindle drilling head, Drills and Reamers; Type, specifications; Numerical problems related to cutting speed, feed, depth of cut and machining time.

Unit VI

Grinding Machines: Definition, Composition of Grinding wheel, Standard marking of Grindingwheel, Shapes of Grinding wheels; Types of Grinding Machines (cylindrical, surface); Dressing and Truing of Grinding wheels; machining time; Centreless grinding, Honing, Lapping, Super finishing.

Unit VII

Boring Machines: Type of boring machines (horizontal, vertical, fine boring machine), Boring tools,deep hole boring, Machining time, Jig boring (description, hole location procedure).

Unit VIII

Broaching Machines: Types of Broaching machines, Broaching tools, Materials for Broach, Cuttingaction, Chip disposal, applications of broaching, advantages and limitations.

Unit IX

Gear Manufacturing: Methods used in production of spur, bevel and worm gears (Powdermetallurgy, Moulding, Forming, Rolling, Gearhobbing and shaping), Gear finishing.

Books Recommended:

1. Manufacturing Processes by Myron L. Begeman (John Wiley & Sons)
2. Production Technology by H.M.T.(Tata McGraw-Hill Education)
3. Manufacturing processes (Vol. 2.) by HazraChowdhary(Media Promoters &Publishers Pvt. Ltd)
4. Manufacturing Processes by S. Kalpakjian (Pearsons)
5. Workshop Technology (Vol.2) by B.S Raghuwanshi (DhanpatRai& Co.)

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): The aim of the course is

- (1) To understand various types of engineering materials and their physical as well as mechanical properties.
- (2) To understand various heat treatment processes on different metals and alloys, phase transformations, various equilibrium diagram.

Course outcomes (CO):

After the completion of this course the students are able to know

1. Complete information of metallurgical characteristics (atomic structures, equilibrium diagram, phase transformation) of engineering materials (ferrous and non-ferrous),
2. Mechanical behaviors of the materials and application of heat treatments processes in industries.

Detailed Contents

Unit I

Atomic structure of metals, crystal structure, crystal lattice of (i) Body centered cubic (ii) face centered cubic (iii) closed packed hexagonal, crystallographic notation of atomic planes, polymorphism and allotropy, Solidification of crystallization (i) nuclear formation (ii) crystal growth (iii) crystal imperfection. Elementary treatment of theories of plastic deformation, phenomenon of slip. Twinning. Dislocation. Identification of crystallographic possible slip planes and direction in F.C.C. B.C.C. C.P.H., recovery, re-crystallization, preferred orientation causes and effects on the property of metals.

Unit II

Introduction to Engineering materials; their mechanical behavior, testing and manufacturing properties of materials; physical properties of materials; classification of engineering materials.

Unit III

General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagrams of Binary system in which the components form a mechanical mixture of crystals in the solid state and are completely mutually soluble in both liquid state. Equilibrium diagrams of a systems whose components have complete mutual solubility in the liquid state and limited solubility in the solid state and in which the solid state solubility decreases with temperature; Equilibrium diagram of alloys whose components have complete mutual solubility in the liquid state and limited solubility in solid state (Alloy with a peritectic transformation) Equilibrium diagrams of a system whose components are subject to allotropic change. Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram: (i) Formation of Austenite (ii) Transformation of austenite into pearlite (iii) Martensite transformation in steel, time temperature transformation curves.

Unit IV

Principles and applications of heat treatment processes viz annealing, normalizing, hardening, tempering; harden ability & its measurement, surface hardening processes. Defects in heat treatment and their remedies; Effects produced by alloying elements on the structures and properties of steel. Distribution of alloying elements (Si.Mn.Ni. Cr. Mo. TL. AL) in steel.

Books Recommended:

1. Engg. Physical Metallurgy by Y. Lakhtin, (Mir Publishers)
2. Heat Treatment of Metals by B. Zakhary (Peace Publishers)
3. Engineering Metallurgy by V. Raghavan (PHI Learning Pvt. Ltd)
4. Introduction to Physical Metallurgy by Avner (Tata McGraw Hill)
5. Material Science & Metallurgy by O.P Khanna (DhanpatRai& Co.

PE - 14405 Industrial Organization & Management

Internal Marks: 40

LTP

External Marks: 60

400

Total Marks: 100

Course objectives (C Obj.): The aim of the subject is to make students aware with-

1. Types of business organization, organization structure characteristics, departmentalism.
2. Concepts of industrial psychology and Management by Objectives.
3. Management concepts, Need for Management, Management functions, scientific management.
4. Need for planning, characteristics, steps in planning, Principles of Organizing, formal and informal organization, Steps in organizing.

Course outcomes (CO): After studying the course the student are able to-

1. Understand types of business organization and concepts of industrial Psychology.
2. Act as the supervisor and leader in Industrial Environment.
3. Plan and organize the basic Industrial activities.
4. Understand the modern management concepts like MBO, Management functions, scientific management

Detailed Contents

Unit I

Industrial Organization: Types of business organization, organization structure characteristics, departmentalism, authority-span of control- matching a job- division of labor-lateral relationship-delegation-chain of command-types of organization structures: line or sealer, functional, line and staff and functional committee, organization chart- question

Unit II

Industrial Psychology: Introduction-definition-classification-scope-basic concept-role application of industrial psychology Management by Objective: Definition, procedure, advantages and disadvantages of MBO, Problems in approach of MBO in India Management concepts, Need for Management, Management functions, Scientific management, Modern management approaches: Introduction to Japanese management concepts, Systems concept, Organizations as system, Approaches to management of systems.

Unit III

Planning: Need for planning, characteristics, steps in planning, Principles of Organizing, formal and informal organization, Steps in organizing, span of control, organization charts, Types of organization, Authority and Responsibility. Directing: Characteristics, Principles of directing, Supervision, Activities of Supervisor, Leadership styles, Path goal approach, Effective Leadership, Management grid, Leadership continuum.

Unit IV

Communication: Process, Types, Barriers to effective communication. Co-ordination: Introduction, Principles and Problems in Co-ordination. Management Information System: Concept, Characteristics and importance of MIS, Types of Information systems, role of computers in MIS, Operating elements of MIS, Information needs of MIS, Functions of information systems, Management reports, Strategic and project planning for MIS, Objectives and plans of MIS with business plans, Project Planning for MIS.

Books Recommended:

1. Principles of Management by Koontz and donell (Tata McGraw Hill)
2. Information Systems for Modern Management by Mudrick.Ross and Clagget (PHI)
3. Industrial Organization and Engineering Economics by Sharma and Banga, (Khanna Publishers)

PE - 14406 Design of Machine Elements Lab**Internal Marks: 30****External Marks: 20****Total Marks: 50****LTP****002**

1. Select a daily use product and design the conceptual design by applying the design process talking the controlling parameters.
2. Make a list of mechanical components and know their materials and suggest some alternative materials for the each of them.
3. Design a wall bracket, which is being used in real life by actual measurement of load.
 - a. Welded joints
 - b. Riveted and bolted joints and justify your findings
4. Find a flange coupling in the college laboratory and justify its design by actual measurements.
5. Design a shaft used in some practical application, by actual working and loading conditions.
6. Select a braking system lever (both hand and foot lever) and justify the design parameters.
7. Justify the design of single plate clutch of an engine assembly.

PE - 14407 Fluid Mechanics & Fluid Machinery Lab**Internal Marks: 30****LTP**

External Marks: 20
Total Marks: 50

002

1. To study flow through a variable area duct & verify Bernoulli's energy equation.
2. To determine coefficient of discharge for venturimeter.
3. To determine coefficient of discharge for orifice.
4. To study transition from laminar to turbulent flow and to ascertain lower critical Reynolds No.
5. To determine friction coefficients for pipes of different materials.
6. To draw Characteristics of Francis Turbine.
7. To study constructional features of reciprocating pump & to perform test on it for Determination of pump performance.
8. To draw the characteristics of pelton turbine
9. To draw characteristics of centrifugal pump.

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
0 0 2

1. Preparation of detailed working sketches describing constructional features of following machines through drawing/ sketches:-
 - a. Lathe
 - b. Capstan & Turret Lathe
 - c. Radial Drilling Machine
 - d. Universal Milling Machine
 - e. Shaper and Planer
 - f. Plastic Moulding Machine
 - g. Grinding Machines (Surface, Cylindrical)
 - h. Gear Cutting Machines etc.
 - i. Hydraulic Press
2. Study of lubrication system in the machine tools.
3. Advanced exercises on Lathe where the students will work within specified tolerances, cutting of V-threads and square threads (internal as well as external).
4. Production of machined surfaces on shaper and planer.
5. Exercises on milling machines; generation of plane surfaces, production of spur gears and helical Involute gears, use of end mill cutters.
6. Grinding of single point cutting tool, cutters and drills.
7. Study of recommended cutting speeds for different tool-work material combinations.
8. Identification of different cutting tool and work materials.

External Marks: 20
Total Marks: 50

002

1. Study of different Engineering materials and their Mechanical properties.
2. To study the microstructures of the following materials
 - (i) Hypo Eutectoid & Hyper Eutectoid steels.
 - (ii) Hypo- Eutectic cast Iron and Hyper Eutectic cast Iron.
 - (iii) Grey and white cast Iron
 - (iv) Nodular and Malleable cast Iron
 - (v) Non-ferrous metals i.e. Al. Mg. Cu. Ni. Sn. And their alloys.
3. Study of Iron carbon diagram and its engineering applications.
4. Annealing of steel, Effect of annealing temperatures and time on hardness.
5. Study of microstructure and hardness of steel at different rates of cooling.
6. Hardening of steel, effect of quenching medium and agitation of the medium on hardness.
7. Effect of carbon percentage on the hardness of steel.
8. Harden ability test by Jominy's End quench test.
9. Normalizing, tempering of steel components.
10. To study the case hardening processes i.e. carburizing, Nitriding, cyaniding etc.
11. To study and construct the T-T-T diagram for steels.

Fifth Semester

PE - 14501 Operations Research

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): This subject is used extensively in business, industry and government sector. The aim of the course is

1. To analytical use methods such as mathematical programming, simulation, queuing theory, multi criteria analysis which are helpful in assessing the various practical problems with the appropriate logical structure.
2. The subject also enhances the skill of undergraduate students in clarifying critical data elements and their role as model inputs.
3. To solve the networking problems in various projects which are time dependent

Course outcomes (CO):

At the end of this course, the students are able to

1. To access, analyze the various business, industry and defense problems on the basis of managerial decision making.
2. The students are able to structure any real-life situation into a mathematical model
3. Abstracting the essential elements so that a solution relevant to the decision maker's objective can be sought.

Detailed Contents

1. **Introduction:** Introduction, characteristics, objectives and necessity of operation research (OR), scope of OR in industry and management. Role of computers in OR, limitations of OR.
2. **Linear Programming:** Introduction to linear programming, formulation of linear programming problems, graphical solution, simplex algorithm, computational procedure in simplex, duality and its concept, application of L.P. model to product mix and production scheduling problems, limitations of linear programming.
3. **Transportation model:** Definition of transportation model, formulation and solution methods, and degeneracy in transportation problems.
4. **Assignment Model:** Definition of assignment model, comparison with transportation model, formulation and solution methods, the travelling salesman problem.
5. **Queuing Models:** Application of queuing models, characteristics of queuing models, single channel queuing theory, solution to single channel with poisson arrivals and exponential service infinite population model, Industrial applications of queuing theory.

6. **Simulation:** Concept and use of simulation, advantages and limitations of the simulation technique, generation of random numbers, Monte-Carlo simulation, computer-aided simulation: applications in maintenance and inventory management.
7. **PERT and CPM:** Work breakdown structure, network logic, critical path, CPM and PE - RT, slack and floats. Resources Leveling & Time cost trade off.

Books Recommended:

1. P.K. Gupta and D.S.Hira, "Operations Research", S. Chand and company
2. A.H. Taha, "Operation Research", Macmillan Publishing Company
3. W.D. Miller and M.K Starr, "Executive Decisions and operations Research", Prentice Hall Inc, Englewood Cliffs, N.J,
4. Vijay Gupta Bhushan Kumar K.K.Chawla, "Applied Operation research", Kalyani Publishers
5. Dr. R. K. Gupta, "Operations Research", Krishna publishers
6. Operation research by Manohar Mahajan (Dhanpat Rai & Co. Publisher)

PE - 14502 Machining Science

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): This subject realizes the importance of metal cutting and diversity in this process. Aim of the subject is

1. To study the fundamentals of mechanics of the machining process using an analytical approach.
2. It analyses major improvements in tool design, tool materials and machining techniques.
3. This subject also deals with the numerical problems used for evaluating the different machining conditions.

Course outcomes (CO): At the end of the course student are able to understand:-

1. Tool geometry of the basic cutting tools like single point cutting tool, drills etc.
2. Also the problems related with the measurement of cutting forces, tool wear and tool life will be understood and tackled with technical approach.
3. They are also able to design various tools on the basis of their geometry and material.

Detailed Contents

1. **Introduction To Machining Processes:** Definition and classification of machining processes; Introduction to single point, multipoint and abrasive cutting tools. Introduction to different machining processes parameters in turning, drilling, boring, milling, shaping, planning and grinding operations.
2. **Tool Geometry:** Importance of tool geometry, geometry of single point cutting tool, milling cutters, drilling tools and broaching tools.
3. **Mechanics Of Metal Cutting:** Chip formation process, type of chips, orthogonal cutting, oblique cutting, Merchant Theory, calculations of shear angle, shear stress, shear strain, strain rate, kinetic coefficient of friction; velocity relations, calculation of various forces, Lee and Shaffer theory.
4. **Tool Wear And Tool Life:** Introduction, types of tool wear, wear mechanism, tool life, variables affecting the tool life, determination of tool life exponents, machinability, simple numerical problems.
5. **Thermal Aspects Of Machining:** Introduction, equations of heat flow, temperature in orthogonal cutting, experimental determination of cutting temperatures, cutting fluids, their selection and application.
6. **Measurement Of Cutting Forces:** Introduction, need, and basic methods of measuring cutting forces, introduction to dynamometers, working principles and construction of lathe dynamometer, drilling dynamometer and milling dynamometers.
7. **Economics Of Machining:** Machining cost, optimum cutting speed, restrictions on

cutting conditions, and comparison of the criteria.

Books Recommended:

1. G.K. Lal, "Introduction to Machining Science," New Age International Ltd,
2. B.L. Juneja, G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools",
New Age International Ltd
3. A. Bhattacharya, "Metal cutting Principles", CBS Publishers
4. R.K. Rajput, "Production Technology", S Chand and company
5. P.C. Sharma, "Production Engineering" S Chand and company
6. Fundamentals of Metal Machining & Machine Tools by Winston A. Knight,
Geoffery Boothroyd

PE - 14503 Engineering Metrology

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): Metrology is the science of measurements. The course is concerned with the

1. Establishment, reproduction, conservation and transfer of units of measurements and their standards.
2. The course of engineering metrology involves learning of concepts in precise measurements requiring the use of apparatus and equipments (instruments) to permit the degree of accuracy required to be obtained.
3. Metrology is not restricted only to standards of length and mass. It also includes the development of various instruments for measurements and their calibration.

Course outcomes (CO): Studying the course the students are able to use

1. The concepts in modern engineering plant with different shops like Tool Room, Machine Shop, Press Shop, Plastic Shop, Pressure Die Casting Shop, Electroplating and painting Shop, and Assembly Shop.
2. In the Research, Development, and Engineering department also.
3. Various standard equipments which are used to calibrate other working standards.
4. Students can also contribute in the development of new standards.

Detailed Contents

- 1. Limits, Fits And Tolerances:-** Concepts of interchangeability, need for standards system of limits, fits and tolerances. BIS:919:1963 standard system, selection of limits and fits, exercise on limits, fits and tolerances, design principles for limit gauges, Taylor's principles, types of limit gauges, tolerances on limit gauges. Design of limit gauges.
- 2. Measuring And Gauging Instruments:-** Mechanical linear and angle measuring instruments, vernier calipers, micrometers, dial gauges, bevel protectors, sine bars, spirit level, optical instruments autocollimator, tool room microscope. Comparators; principle, types of comparators, mechanical, optical, pneumatic, electrical comparators.
- 3. Geometrical Metrology And Surface Finish:-** Concepts of form errors; straightness, flatness, roundness errors and their measurements, concept of micro and macro errors, measurement of surface roughness, stylus method using, mechanical, optical, electrical magnification methods.
- 4. Screw Threads And Gear Metrology:-** Elements of screw threads metrology, measurement of major, minor and effective diameters of external and internal screw threads, measurement of pitch and screw thread angle, Elements of gear metrology, measurement of gear tooth thickness, gear profile, pitch and runout for involute gears, gear rolling test.

5. **Transducers:-**Transducers, types, governing principles of transducers; Examples. Displacement measurement, detailed study of various types of displacement transducers, Velocity measurement, linear and angular, study of velocity transducers.
6. **Force, Torque and Pressure Measurement:-**Mechanical, pneumatic, and hydraulic load cells; torque measuring devices; dynamometers, types of strain gauges, factors affecting strain measurement; Electrical strain gauges, gauge material, fixing methods, strain gauge circuits, examples, use of strain gauges for the measurement of the force and torque, Pressure measurement, types of pressure transducer; differential pressure measuring devices, performance characteristics; low and high pressure Measurement.

Books Recommended:

1. R.K.Jain, "Engineering Metrology", S. Chand and Company
2. I.C.Gupta, "Engineering metrology", Dhanpatrai & sons delhi
3. D.S.Kumar, "Mechanical Measurement & Control", Metropolitan Publishers
4. Doebelin, "Mechanical Measurement", McGraw Hill
5. Gharam T. Smith, "Industrial Metrology", Springer

PE –14504Metal Forming

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): Metal forming processes form back bone of steel industry. The aim of the subject is to

1. Understand the behavior and properties of metal, applied mechanics, metallurgy and heat transfer during various metal forming processes.
2. The fundamentals of plastic deformation i.e. metal flow, flow stress of metals, yield criteria, friction at tool material interface, temperature and lubrication.
3. It also focuses on lubrication mechanisms, different lubricants for various metal forming processes and metal forming machines.
4. The subject also covers the analytical analysis and defects of various metal forming processes like rolling, drawing, extrusion etc.

Course outcomes (CO): After studying the course the student are able to

1. Correlate the theory of metal forming with the actual processes in the industry.
2. Suggest better lubricants for various metal forming processes.
3. Understand the state of stress in various metal forming processes.
4. Flow rules by using different analytical methods such as finite element analysis, upper bound method.

Detailed Contents

1. **Introduction:** Classification of metal forming processes, hot and cold working processes and their advantages and disadvantages. Variables in metal forming process: Work material, tooling, friction and lubrication at tool work piece interface, mechanics of deformation, effects of deformation on mechanical and metallurgical properties, Tresca's and Von Mises yield criteria.
2. **Rolling:** Rolling of flat slabs and strips, stress evaluation of roll pressure for homogenous deformation with constant yield stress, assumptions and their justifications, evaluation of load, torque and mill power for cold rolling process, stress evaluation for rolling with high friction. Friction hill, effect of elastic deformation, minimum thickness of strip in rolling, empirical equation for measurement of rolling loads for hot and cold rolling, rolling defects, causes and remedies.
3. **Forging:** Determination of forging pressure for thin strip for low and high friction conditions, pressure distribution for sticking and sliding friction regions, forging of flat circular discs.
4. **Drawing and extrusion** processes for rods, wires and tubes, evaluation of drawing stress and force for wire drawing and extrusion under homogenous deformation without and with strain hardening conditions through conical dies, effect of friction, maximum reduction per pass under frictionless condition, effects of back pull and die geometry, optimum die angle, drawing stress for tube drawing with a conical die with and without internal support, wire drawing and extrusion defects, causes & remedies.

- 5. Metal forming lubrication**, Friction at die-work piece interface, lubrication mechanisms, boundary lubrication, mixed lubrication, hydrodynamic lubrication, lubricants for wire drawing, rolling, extrusion, forging and sheet metal working. Metal forming machines, classification and characteristics of metal forming machines, metal forming hammers and presses

Books Recommended:-

1. Row, "Principles Industrial metal working processes", Prentice Hall of India
2. Surinder Kumar, "Metal working", DhanpatRai and Sons
3. Avitzur, "Metal Forming", Marcel Dekker
4. William F. Hosford, Robert M. Caddell, " Metal Forming: Mechanics and Metallurgy", Cambridge university press
5. R. H. Wagoner, J.-L. Chenot, " Metal Forming Analysis", Cambridge university press

PE - 14505 Machining Science Lab

Internal Marks: 30

External Marks: 20

Total Marks: 50

LTP

002

1. Prepare a HSS single point cutting tool of given tool signature.
2. By using lathe tool dynamometer measure the cutting forces in all directions and calculate the following:
 - a. Shear plane angle
 - b. Coefficient of friction
 - c. Power consumption
3. By using the drill dynamometers measure the torque, and thrust in Drilling operation.
4. By using the tool work thermocouple, measure the tool chip interface temp
5. To determine chip reduction coefficient in turning.
6. To study the different mechanisms of tool wear and their measurements.
7. To determine Taylor Tool life exponents by Facing test
8. To study the effect of cutting variables on surface finish in any cutting (Turning, Drilling, Milling, Shaping, grinding etc) operation

PE – 14506 Engineering Metrology Lab**Internal Marks: 30****External Marks: 20****Total Marks: 50****LTP****002**

1. Measure the surface roughness of the given workpiece on surface roughness measuring instrument.
2. Measure the taper angle in the given workpiece by using sine bar & slip gauges.
3. Measure the various gear tooth profile parameters.
4. Perform the machine tool alignment test on lathe and radial drilling machine.
5. To measure various elements of screw thread by (a) Tool Makers Microscope & (b) Profile Projector.
6. To check the flatness of surface plate by Auto-collimator.
7. To check the diameter of a rod by compactors and slip gauges.
8. Find out the strain in a given workpiece under given loading by using strain gauges. Calibration of pressure gauge

PE – 14507 Metal Forming Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

1. To study of the effect of clearance and shear angle on the blanking and piercing operations.
2. To determine the effect of percentage of reduction and the semi-cone angle of the die on the drawing load.
3. To find the effect of percentage of reduction and the die geometry on extruding force.
4. Experimental determination of coefficient of friction for metal forming.
5. Study of the drop forging operation (flowability, forging load etc by plasticine model.
6. To determine roll load in the sheet rolling process

Sixth Semester

PE - 14601 Industrial Engineering

Internal Marks:
External Marks:60
Total Marks: 100

LTP
400

Course objectives (C Obj.): To provide an Excellent and innovative education setting to our students so they can learn and discover how complex systems work better. The aim of the course is

1. Understand and apply the principles of science, technology, engineering, and math involving industry-relevant problems.
2. Perform as industry leaders in the global market place, capable of successfully planning, controlling, and implementing large-scale projects.
3. Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.
4. Maintain high standards of professional and ethical responsibility.

Course outcomes (CO): After the completion of this course the students are able to know

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. An ability to function on multidisciplinary teams.

Detailed Contents

1. **Introduction:** Definition and scope of industrial engineering, role of an industrial engineer in industry, functions of industrial engineer. Department and its organization, qualities of an industrial engineer
2. **Plant Layout And Material Handling:** Different types of layouts viz. Product, Process and combination layouts, Introduction to layouts based on GT, JIT and Cellular, manufacturing systems, development of plant layout, types of material handling equipment, relationship of material handling with plant layouts.
3. **Work Study:** Areas of applications of work study in industry, method study and work measurements and their interrelationship, reaction of management and labour to work study, role of work study in improving plant productivity and safety.
4. **Method Study:** Objectives and procedure for methods analysis; select, record, examine, develop, define, install and maintain, recording techniques, micro motion and macro motion Study; Principles of motion

economy, normal work areas and workplace design.

5. **Work Measurement:** Objectives, work measurement techniques - time study, work sampling, Predetermined motion time standards (PMTS), Determination of time standards, Observed time, Basic time, Normal Time, Rating Factors, allowances, Standard Time.
6. **Value Engineering:** Types of values, concept of value engineering, phases of value engineering Studies, application of value engineering.
7. **Work Design:** Concepts of job enlargements, job enrichment and job rotation, effective job design considering technological and behavioral factors, Scientific Management, Business Process, Re Engineering, Gillworth Contribution towards work system design.
8. **Ergonomics:** Introduction to ergonomics consideration in designing Man Machinesystems with special reference to design of displays and controls.

Books Recommended:

1. Hicks, "Industrial Engg. And management ", Tata McGraw Hill.
2. Ulrich, "Product Design and Development", Tata McGraw Hill
3. Suresh Dalela and Saurabh, "Work Study and Ergonomics", Standard Publishers.
4. R. Bernes, "Motion and time study", John Wiley and sons.
5. D. J. Osborne, "Ergonomics at work", John Wiley and sons.
6. Work study by ILO
7. Industrial engineering and production management by marten Telsang (S.Chan

PE - 14602 Product Design & Development

Internal Marks: 40

LTP

External Marks: 60

310

Total Marks: 100

Course objectives (C Obj.): The objective of this course is to teach the students about the Mapping the strategic *objectives* between new product development and product design. The aim of the course is

1. Describe the Basic elements and concept of visual design-line color
2. To study Elementary forms their characteristics and significance in design and form transition,
3. Meaning and objectives of product graphics and basic principles of graphic design
4. Phenomena of Standard fastening and joining details in different materials.

Course outcomes (CO): After the completion of this course the students are able to know

1. Awareness of the elements and principles in creating successful visual compositions.
2. Determination of design consideration like shape mass, unity and variety.
3. Principles of graphic design balance, proximity, alignment, repetition and contrast.
4. Temporary and permanent joints and plastic products.

Detailed Contents

1. **Visual Design:** Basic elements and concept of visual design-line color, Balance proportion, Size shape mass, unity and variety, Special relationships and composition in two and three dimensions.
2. **Form & Color** Elementary forms their characteristics and significance in design. Form transition, Form in relation to ergonomics, material and manufacturing process, color as an element of design, color clarification dynamics, interrelation of colors, colors and traditions; Psychological use of color form and material.
3. **Product Graphics:** Meaning and objectives of product graphics. Basic principles of graphic design, Visual communication aspects of product graphics, Graphics of displays and control panels,
4. **Product Detailing:** Standard fastening and joining details in different materials; Temporary and permanent joints: Detailing for plastic products, Detailing for fabricated products in sheet metal.
5. **Products Development:** Definition and objective, Role of designer in product development. Manufacturing and economic aspects of product development, Product promotions, product developments, Concurrent Engineering & Standardization

Books Recommended:

1. Mayall W.H., "Industrial Design for Engineers", London Liiffee Books Ltd. 1967
2. Dale Huchingson R, "New Horizons for Human Factors in Design", McGraw Hill Company 1981. Industrial Design-Mayall
3. McCormick K.J. (Ed), "Human Factor Engineering", McGraw Hill Book Company Ltd. USA 1992
4. Moustapha Concurrent Engineering in Product design & development, New Age international publisher.

PE - 14603 Tool and Cutter Design

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): Main objective of the subject is to give the student an understanding of fundamentals of specific areas of tooling. The aim of the course is

1. To describe cutting tool materials and theories of tool failure.
2. To study the fundamentals of cutting tool design
3. To study design of drills and principal types twist drill geometry
4. Radial feed and tangential type form tool construction and design

Course outcomes (CO): After the completion of this course the students are able to know:-

1. Principles elements of cutting tools and tool geometry.
2. Design elements and geometrical parameters of the tool point.
3. Purpose and principal of Twist drill geometry, construction and design. Determination of correct profile of form tools

Detailed Contents

- 1. Introduction:** Cutting Tool materials, desirable properties of cutting tool materials, Relative properties of the various tool materials and their uses. Fundamentals of cutting tool design. Principles elements of cutting tools and tool geometry.
- 2. Design of Single Point Tools:** Design Elements and Geometrical parameters of the tool point. Design for dimensions of H.S.S Tools. Construction and design of carbide and ceramic tipped tools, Chip breaker purpose construction and design, Design of High production Tools, Principles types and their design.
- 3. Design of Drills:** Purpose and principal types of drills, twist drill geometry, construction and design.
- 4. Design of Form Tool:** Purpose and types of form tools, radial feed and tangential type form tool construction and design.
- 5. Design of milling cutters:** Purpose, types and geometry of milling cutters, Design of profile sharpened plain milling cutter, face milling cutter, side milling cutters.
- 6. Design of Broaches:** Purpose and types of broaches, Design and construction of internal broaches and external surface broaches.
- 7. Design of Reamers:** Elementary discussion on various types of reamers, construction and geometry of reamers.

Books Recommended

1. Cyril Donaldson, George H. LeCain, V. C. Goold, "Tool Design", Tata McGraw Hill
2. Arshinov & Others, "Metal Cutting Principles and cutting Tool Design and Production", Mir Publications
3. Helmi A. Youssef, Hassan El-Hofy, "Machining Technology", Taylor and Francis Group
4. Leo J. St. Clair, "Design and use of cutting tools", McGraw-Hill
5. William R. Jeffries, "Tool design", Prentice-Hall

PE - 14604 Non Traditional Machining

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course Objectives (C Obj.): The objective of this course is to teach the students about the modern machining technologies in detail. The material removal mechanisms and material removal rates in Non Traditional Machining processes. . The aim of the course is:-

1. Detailed study about advanced machining processes and their applications.
2. To describe principles of nontraditional machining processes and differences of same with conventional machining processes.
3. To study about material removal mechanisms in various non conventional machining processes.
4. To study about material removal rates in processes like Ultrasonic machining and Abrasive Flow Machining, Abrasive Water Jet Machining, Electrochemical Machining.

Course Outcomes (CO): After the completion of this course the students are able to know :

1. The difference between traditional machining processes and the modern machining processes.
2. About the technologies to machine difficult-to-machine materials, such as metal-matrix composites, monolithic and composite ceramics, aluminates, and high-performance polymers.
3. Material removal mechanisms and material removal rates in different processes.
4. Applications of nontraditional process in industry.

Detailed Contents

1. **Modern Machining Processes:** An Overview, trends in advanced machining, classification, comparison between conventional and non-conventional machining process selection. Flexible machining system, computer integrated manufacturing.
2. **Advanced Mechanical Processes:** Ultrasonic machining and Abrasive Flow Machining, Abrasive Water Jet Machining- elements of process, process parameters, applications and limitations.
3. **Electrochemical and Chemical Removal Processes:** Principle of operation, elements and applications of Electrochemical Machining, Electrochemical grinding, Electrochemical de-burring, Electrochemical honing, Chemical Machining:
4. **Thermal Metal Removal Processes:** Electric Discharge Machining- Mechanism of metal removal, , electrode feed control, dielectric fluids flushing, selection of electrode material, applications. Plasma Arc Machining- Mechanism of metal removal, PAM parameters, Equipment's for unit, safety precautions and applications. Laser Beam machining- Material removal, limitations and advantages. Hot machining- method of heat, Applications and limitations. Electron-Beam Machining-, Generation

and control of electron beam, process capabilities and limitations

5. **Hybrid Machining Processes:** concept, classification , application ,Advantages

Books Recommended:-

1. P.C. Panday and H.S. Shan, “Modern Machining Processes “,Tata McGraw Hill
2. G. Boothroyd and W.A. Knight, “Fundamentals of Machining and Machine Tools”,Mareel Dekker Inc.
3. G.F. Benedict, “Non traditional Manufacturing Processes”, Marcel Dekker Inc.
4. E. J. Weller, “Nontraditional Machining Processes”, Society of Manufacturing Engineers, Publications
5. Carl Sommer, “ *Non-Traditional Machining Handbook*”, Advance Publishing, Incorporated.
6. Advance Machining process By Vijay K. Jain(Allied Publishers

PE - 14605 Industrial Engineering Lab**Internal Marks: 30****External Marks: 20****Total Marks: 50****LTP****002**

1. Determination of standard time for a given job using stopwatch time study.
2. Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3. Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4. To carry out a work sampling study in selected industry.
5. To conduct process capability study for a machine in the workshop.
6. To design a sampling scheme based on OC curve.

PE - 14606 Product Design And Development Lab

Internal Marks: 30

External Marks: 20

Total Marks: 50

LTP

002

Design Exercise: Design and Develop a daily use product involving the product design fundamentals

1. Study the product design message of the commonly used product and use them to define the product message for selected product
2. Study the conceptualization process and implement it to the selected product in the design exercise.
3. Study the role of forms and shapes in product design and apply it to the selected product
4. Apply the principles of visual design forth detailed design of the selected product.
5. Develop the product detailing for the selected product
6. Study the economic aspects of the product development and develop/select the manufacturing process and material for the product considering cost as the major parameters.
7. Study the principles of graphic design and apply it to the product

PE-14607 Tool and Cutter Design (Lab)

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP 002

1. To understand tool signature of single point cutting tool and also prepare the same using tool and cutter grinder.
2. To study the effect of chip breaker on chip reduction coefficient (with different types of workpiece materials like M.S, Cu, Brass, C.I etc.)
3. To understand the geometry of twist drill. Also prepare the same using conventional machining process.
4. To prepare profile shaped plain milling cutter and understand process parameters in Up/down milling with conventional workplace material.
5. To design broach for external/internal holes and perform parametric optimization for given jobs.
6. To design and study radial feed and tangential type form tool.

Seventh Semester

PE - 14701 Computer Integrated Manufacturing

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): The objective of this course is to teach the students about the various CAD/CIM principles, tools and their basic forms. The aim of the course is :

1. To describe the various computer graphics system and workstation applications.
2. To describe the principles of the CAD software and their related tools.
3. To describe the relation between CAD and CAM.
4. To teach about numerical control methods for manufacturing.

Course outcomes (CO): After the completion of this course the students are able to know:-

1. About working of different computer graphics systems.
2. Enables students to improve their skills on manufacturing with computers.
3. Enhance the knowledge regarding the manufacturing aspects of the machining.
4. Group technology and computer aided process planning will help in planning the various schedules employed in an industrial set up.

Detailed Contents

1. **Introduction:** Overview of manufacturing processes, types of manufacturing systems, the product cycle, computer's role in manufacturing, sources and types of data used in manufacturing, Central Processing unit, memory input/output section, computer programming, minicomputer, microcomputer, P.C., Super Computers.
2. **Computer Aided Design:** Historical Perspective, Components of CAD systems, the design process, Application of Computer for Design, Manufacturing Data Base. General Information of various Software for CAD, Relation of CAD with CAM
3. **Numerical Control:** THE BEGINNING OF CAM: Historical Background, basic components of NC systems, NC Procedure, NC coordinate system and machine motions, applications and economics of NC, part programming- manual and computer assisted the APT Language.
4. **Computer Controls in NC Systems:** Problems with conventional NC computer numerical control, direct numerical control, combined CNC/DNC systems, adaptive control machining system computer process interfacing, New development and latest trends.
5. **Computer Aided Process Planning:** Traditional process planning, retrieval process planning system, generative process planning, machinability data system, computer generated time standards.
6. **Group Technology:** Introduction, part families, part classification and coding, coding system and machining cells.
7. **Computer Aided Production Management Systems:** Traditional Production, Planning and Control, Introduction to computer aided PPC, Introduction to computer aided inventory

management, manufacturing resource planning (MRP- II), computer process monitoring and shop floor control, computer process control.

- 8. Computer Aided Quality Control:** Traditional quality control, computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.
- 9. Computer Aided Material Handling:** Traditional Material handling, computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly.
- 10. Computer Integrated Manufacturing Systems:** Introduction, types special manufacturing systems, flexible manufacturing systems (FMS), Machine tools and equipment, material handling systems, computer control systems.

Books Recommended:

1. Groover & Zimmer, "CAD/ CAM", Prentice Hall
2. Groover, " Automation Production Systems and CIMS", Prentice Hall.
3. Beasanat & Lui, "CAD/ CAM", EWP.
4. Material Handling Hand Book, McGraw Hill.
5. Groover Mitchell, "Industrial Robotics", McGraw Hill.
6. Computer Integrated Manufacturing by A.W. Sche

PE - 14702 Machine Tool Design

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
310

Course objectives (C Obj.): This subject makes the students aware of general requirements of machine tools. The aim of the course is

1. To study the kinematics of machine tools.
2. To design the transmission drives of machines.
3. To make students aware of different operational and control features of a machine.
4. To give knowledge of speed and feed boxes.

Course outcomes (CO): After the completion of this course the students are able to know

1. The various requirements of the machines.
2. Access the various feed drives and spindle drives design on the basis of varying load conditions.
3. Get equipped with the knowledge of machine tool dynamics.
4. Access machine tools control system which will further help in recognizing the different operational conditions on the machine.

Detailed Contents

1. **Introduction:** General requirements to machine tools, Machine tool design recommendations, Classification of motions to shape surface, Machine tool drives for rectilinear motion, Periodic motion, reversing motion etc.
2. **Kinematics of Machine Tools:** Kinematics or gearing diagram of Lathe, drilling machine, milling machine etc. Main drive and feed drive, principal specification of machine tools.
3. **Design of Kinematics Scheme:** Methods to determine transmission ratios for drives. Development of kinematics scheme, minimum of transmission, transmission groups, Determination of number of teeth on gears.
4. **Speed and Feed Boxes:** General requirement, Design of gear trains, types of speed boxes, speed changing devices, feed boxes, characteristics of feed mechanism, types of rapid traverse mechanisms, variable devices.
5. **Spindle Design and Spindle Bearings:** Main requirements, Materials and details of spindle design, spindle bearings, bearings, types of bearings and their selections, bearing materials.
6. **Bed, Columns, Tables and Ways:** Materials, typical constructions and design.
7. **Machine Tools Control Systems:** Requirement of control system, selection and construction of control systems, Mechanical control system, predilection control, remote control safety devices.

- 8. Machine Tool Dynamics:** Dynamic performance, dynamic and elastic system of Machine, tools. Dynamics of cutting forces, tool chatter.

Books Recommended:

1. Sen and Bhattacharya, "Machine Tools Design", CBS Publishers
2. N.K. Mehta, "Machine Tool Design", Tata McGraw Hill.
3. N. Acherkan, "Machine Tool Design, Four Volumes", Mir Publishers
4. P. H. Joshi, "Machine Tools *Handbook: Design and Operation*", McGraw Hill Professional,
5. S.K. Basu and D.K. Pal, "Design of machine tools", Oxford and IBH

PE - 14703 Industrial Automation and Robotics

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Course objectives (C Obj.): The objective of this course is to teach the students about the concept of fluid power (pneumatic and hydraulic system) as used in basic industrial automation and robots. The aim of the course is

1. To study the basic components of pneumatic and hydraulic system.
2. To study the symbols and graphical representations of pneumatic and hydraulic system components.
3. Study of Fluidics which include Boolean algebra, truth tables etc.
4. Study of robotics which includes the knowledge of various terms used in robots, robotic end effectors, machine vision.

Course outcomes (CO): After the completion of this course the students are able to know

1. Contribution of automation to the industry.
2. To differentiate between components of hydraulic and pneumatic systems.
3. To understand the basics of robots thoroughly this will help them to program.
4. About applications of robots in industries.

Detailed Contents

1. **Introduction:** Concept and scope of automation: Socio economic consideration: Low cost automation.
2. **Fluid Power Control:** Fluid power control elements and standard graphical symbols. Construction and performance of fluid power generators; Hydraulic and pneumatic cylinders - construction, design and mounting; Hydraulic and pneumatic valves for pressure, flow and direction control: Servo valves and simple servo systems with mechanical feedback, governing differential equation and its solution for step position input; Basic hydraulic and pneumatic circuits.
3. **Pneumatic Logic Circuits:** Design of pneumatic logic circuits for a given time displacement diagram or sequence of operations.
4. **Fluidics:** Boolean algebra; Truth tables; Conda effect; Fluidic elements their construction working and performance characteristics: Elementary fluidic circuits.
5. **Transfer Devices and Feeders:** their Classification: Construction details and application of transfer devices and feeders (Vibratory bowl feeder, reciprocating tube feeder and centrifugal hopper feeder).
6. **Electrical and Electronic Controls:** Introduction to electrical and electronic controls such as electromagnetic controllers - transducers and sensors, microprocessors, programmable logic controllers

(PLC); Selection & Industrial Applications, Integration of mechanical systems with electrical, electronic and computer systems.

7. **Robotics;** Introduction, classification based on geometry, devices, control and path movement, End effectors - types and applications: Sensors - types and applications. Concept of Robotic/Machine vision, Teach pendant. Mechanical grippers & their types.
8. **Industrial Applications** of Robots for material transfer, machine loading /unloading, welding, assembly and spray painting operations.

Books Recommended

1. A. K. Gupta, "Industrial Automation and Robotics", Laxmi Publication (P) Limited
2. Anthony Esposito, "Fluid Power with applications" Pearson prentice Hall
3. SR Majumdar, "Pneumatic Control", Tata McGraw Hill
4. SR Deb, "Robotics and Flexible Automation", Tata McGraw Hill
5. Harry Colestock, "Industrial robotics: selection, design, and maintenance.
6. Robert technology Fundamentals by J.G. keramas, Delmar publisher

PE-14704 Industrial Tribology

Internal Marks: 40
External Marks: 60

LTP
400

Total Marks: 100

Course Objectives(C Obj.):The objective of this course is to teach the students about the concept of friction, wear and lubrication encountered in industrial operations. The aim of the course is:-

1. To enable the students to understand laws of sliding friction +measurement of friction.
2. To understand different laws of wear & measurement of wear in various environmental conditions.
3. To enable the students to leave the prevention and control of wear and friction in machines.
4. To understand the mechanisms of lubrication & also to make the students understand the solution of Reynold's equation in 2D & 3D flow.
5. To enable the students to understand the design of bearings, Reynold's slip and Heath cote concept for selection.

Course Outcomes(CO):-

1. Co-relate the theoretical concept of Tribology with the actual processes in industry.
2. Suggest better lubricants to be used depending upon the environment conditions.
3. Understand the designing of bearings with respect to clearance required, minimum film thickness etc.

Detailed Contents:-

1. **Introduction** Tribological considerations: Nature of surfaces and their contact; Physical & mechanical properties of surface layer, Geometrical properties of surfaces, methods of studying surfaces; Study of contract of smoothly and rough surfaces.
2. **Friction and wear:** Role of friction and laws of static friction, causes of friction, adhesion theory, Laws of rolling friction; Friction of metals and non-metals; Friction measurements.
3. **Definition of wear:-** mechanism of wear, friction affecting wear, wear measurement; Wear of metals and non-metals.
4. **Lubrication and lubricants:** Introduction, dry friction; Boundary lubrication; classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses; properties of liquid and grease lubricants; lubricant additives, general properties and selection.
5. **Special Topics:-** Selection of bearing and lubricant; bearing maintenance, diagnostic maintenance of tribological components; lubrication systems; Filters and filtration.

Books Recommended:

1. O'Conner and Royle, "Standard Hand Book of Lubrication Engg.", McGraw Hills Co
2. Halling, "Introduction to Tribology", Wykeham Publications Ltd.
3. Raymono O. Gunther, "Lubrication", Bailey Bros & Swinfan Ltd.
4. Rearing Systems, Principles and Practice, PT Barwill
5. Basic Lubrication Theory, A Cameron (Indian Edition)

PE – 14705 Industrial Automation And Robotics Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

1. Design and assembly of hydraulic / pneumatic circuit.
2. Study of power steering mechanism using cut piece model
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves
4. Use of direction control valve and pressure control valves clamping devices for jig and fixture
5. Study of robotic arm and its configuration
6. Study the robotic end effectors
7. Study of different types of hydraulic and pneumatic valves

PE- 14706 Computer Integrated Manufacturing (Lab)

Internal Marks: 30

LTP 002

External Marks: 20

Total Marks: 50

1. To understand NC coordinate systems and develop a programme for Gang drilling operation.
2. To write programme by using APT language for:-
CNC drilling
Pick and place operation
3. To develop programme for inventory management (as case study) using MRP –II.
4. To understand and apply optical and non optical computer aided testing techniques.
5. To study and understand flexible manufacturing systems.

PE- 14707 Machine Tool Design Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

LTP
002

1. Construction of kinematics diagrams of the following machines (using tracing paper method / CAD software):
 - a. Lathe Machine
 - b. Drilling Machine
 - c. Milling Machine

2. Construction of Gearing diagrams of the following machines:
 - a. Lathe Machine
 - b. Drilling Machine
 - c. Milling Machine

3. Determination of number of teeth on gears using speed chart, ray diagram and gearing diagram.

PE- 14708 Industrial Tribology Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

L T P
0 0 2

1. To study the wear, coefficient of friction, friction force, weight loss on different materials (MS, Cu, Brass and CI) on Pin on disk setup under following conditions by varying load and velocity:
 - a. Dry under normal and high temperature
 - b. Lubricated under normal and high temperature

2. To study the erosive wear of different materials (MS, Cu, Brass and CI) by varying the following parameters:
 - a. Impingement angle
 - b. Velocity of erodent flow

List of Department Elective Subjects:

Group -I		
S.No.	Code	Name of Subject
1.	DEPE-14901	Industrial Finishing Technology
2.	DEPE-14902	Welding technology
3.	DEPE-14903	Plastic & ceramic technology
4.	DEPE-14904	Non- Destructive Testing
5.	DEPE-14905	Material Handling & Plant Layout
6.	DEPE-14906	Supply Chain Management
7.	DEPE-14907	Applied Elasticity and Plasticity
8.	DEPE-14908	Productivity Management
Group -II		
9.	DEPE-14909	Marketing & Financial Management
10.	DEPE-14910	Modeling & Simulation
11.	DEPE-14911	Estimating & Costing
12.	DEPE-14912	Value Engineering
13.	DEPE-14913	Automobile Engineering
14.	DEPE-14914	Production Planning & Control
15.	DEPE-14915	Jigs, Fixtures& Tool Design
16.	DEPE-14916	Industrial Safety & Environment
17.	DEPE-14917	Mechatronics
Group -III		
18.	DEPE-14918	Maintenance & Reliability Engineering
19.	DEPE-14919	Quality Assurance and Reliability
20.	DEPE-14920	Total Quality Management
21.	DEPE-14921	Material Management
22.	DEPE-14922	Project Management
23.	DEPE-14923	Investment Planning
24.	DEPE-14924	Entrepreneurship
25.	DEPE-14925	Inspection and Quality Control
26.	DEPE-14926	CAD & Computer Graphics

Group-I

DEPE –14901 Industrial Finishing Technology

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. Final Finish Surface Operations

Introduction to finishing operations, significance and applications in Industry, classification of Industrial finishing processes. Mechanical Finishing processes: De-burring, polishing, buffing, barrel and vibratory finishing, spindle finishing, dry and wet blasting, shot peening, power brushing, brush principles, techniques and comparison of the processes. Chemical and electrochemical finishing, chemical polishing. Cleaning, chemical, flame, steam, ultrasonic cleaning, vapor degreasing. Advanced Finishing operations: Magnetic Abrasive finishing, Magnetic Float polishing, Chemo-Mechanical Polishing

2. Coatings:

Inorganic methods, coating system, coating composition and properties, applications, electroplating, equipment and working, electrolytes, Anodizing ;mechanism, characteristic of anodic coating, equipment and electrolytes. Mechanical plating, hard facing, metal hot dipping, galvanizing, tin plating flame spray coating, metallizing, vacuum metalising. sputtering, chemical vapor phase deposition. Painting ;and organic coating, polymerization methods. undercoating, brush dip, flow, Electrolytic spraying. Rust prevention, principles, types selection of coatings, safety.

Books Recommended:

1. B.F. Blumdell, "Introduction to Metal Finishing Equipment", Pergamon Press.
2. Modern Electroplating, John Wiley.
3. Tool and Manufacturing Engineer's handbook, Society of Manufacturing Engineers
4. Electroplating Engineering Hand Book, Reinhold.
5. C.R.Martin, Technology of paints, Varnishes, and Lacquers, Van Nostrand Reinhold.

DEPE - 14902Welding Technology**Internal Marks: 40****External Marks: 60****Total Marks: 100****LTP****400**

1. **Introduction:** Introduction to Welding technology, Classification of welding processes, Metallurgy of welding, metallurgical changes in weld metal, heat affected zone, gas metal reaction, liquid metal reaction and solid state reaction, weldability, Testing of welding joints, weld design and process selection, effects of elements on welding of ferrous and non-ferrous metal and their alloys
2. **Power Sources and metal transfer:** Basic characteristics of power sources for various arc welding processes, arc length regulation in mechanized welding processes, Mechanism and types of metal transfer in various arc-welding processes.
3. **Fusion Welding** Comparison of TIG, MIG and Co₂ welding processes, Plasma arc, submerged arc welding, electro gas and Electro-slag welding,
4. **Solid State Welding:** Classification of Solid State Welding processes, Mechanism of solid state welding. Applications of friction welding, diffusion welding, cold pressure welding and ultrasonic welding. High energy rate welding,
5. **Advanced Welding processes:** Technology, Scope and Application of Electron beam Welding , Laser welding, Under Water Welding processes.

Books Recommended:

1. J. F. Lancaster, "*The Physics of Welding*", Pergamon Press
2. Lancaster, "The metallurgy of welding", George Allen & Unwin Ltd. U.K.
3. Welding Handbook, Vol.1 & 2, Seventh edition; American Welding Society. Metal Handbook Vol.16, 73. ASME.
4. The solid phase welding of metals by Tylecote; Edward Arnold P Ltd. Richard, "Welding and Welding Technology", Mc.Graw Hill.
5. Udin, "Welding for Engineers", Frame & Wuff ; John Miles.

DEPE - 14903 Plastic and Ceramic Technology

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

- 1. Glossary of Terms Associated with Plastic Engineering:-** Thermoplastics and thermo sets, their properties. Mechanical & physical properties of plastics. Selection of plastics for different uses and their limitations.
- 2. Polymer Processing Techniques:-** extrusion, compression and transfer moulding. Injection moulding, blow moulding, thermoforming, rotational moulding, calendaring, Bag moulding reaction moulding.
- 3. Joining and assembling of plastics:** Processes.
- 4. Design of moulds for thermo sets:** Compression moulds, transfer moulds, injection moulds, runner and gate design, vents.
- 5. Design of moulded products,** wall thickness, fillets and radii, ribs, undercuts, drafts, holes, threads, inserts parting lines, surface treatment mould design for avoiding warpage.
- 6. Standards for Tolerances on moulded articles:** Design consideration.
- 7. Casting of acrylics, phenolics and epoxies, polyesters and nylons.**
- 8. Ceramics and non-ceramic phases:** Common ceramics, Crystal structures. Binary and ternary ceramics. Silicates, clays, graphite and carbides, General Properties of ceramics. Deformation and creep. Toughening, Mechanics. Ceramic processing techniques, material selection for general applications and industrial application, limitations of ceramics.

Books Recommended:

1. A.W. Birley, B. Howarth, "Mechanics of plastics processing properties", Hana Publisher edition, 1991
2. J.E. Mark, R. West, H.P. Alcock, "Inorganic Polymers", Prentice Hall, 1992
3. Fried, "Poly. Science and Technology", Prentice Hall
4. Charles Harper, "Handbook of Plastics Technologies", McGraw-Hill.
5. Plastic Engg. Data Book, Glanill

DEPE - 14904 Non-Destructive Testing

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. Introduction:-Classification of techniques of material testing, Need and Significance of Non Destructive Testing methods, type of Non Destructive testing methods,

2. Radiographic Examination:-Radiant energy and radiography, practical applications, X-ray and Gamma -ray equipment, effect of variables on radiographs, requirement of a good radiograph, interpretation of radiograph, safety precautions, Xeroradiography

3. Magnaflux methods:-Basic principles, scope and applications, magnetic analysis of steel bars and tubing magnetization methods, equipment, inspection medium, preparation of surfaces Fluorescent Penetration inspection, Demagnetization

4. Electrical and ultrasonic Methods:-Basic principles, flaw detection in rails and tubes (Sperry Detector), Ultrasonic testing surface roughness, moisture in wood, Detection of defects in ferrous and non ferrous metals, plastics, ceramics, measurement of thickness, hardness, stiffness, sonic material analyzer, proof tests, concrete test hammer

5. Photoelasticity:-Concept and applications of Plane and circular polarization, Photo-stress, models,

Books Recommended:-

1. H.E. Davies, G.E Troxell, GFW Hauck , “The testing of Engg materials”, McGraw Hill Publishers
2. W.H Armstrong , “Mechanical Inspection”, McGraw Hill Publishers
3. Paul E. Mix, P.E., E.E., “ Introduction to *Nondestructive Testing*”, Johan wiley and sons.
4. Baldev Raj, TammanaJayakumar, M. Thavasimuthu” , Practical *Non-DestructiveTesting*”, WoodHead Publishing Limited
5. B. Hull, Vernon B. John, “ *Non-Destructive Testing*”, Springer VerlagGmb
6. Non Destructive testing by Barry hull(Springer)
7. Non Destructive Testing: Methods. Analysis & Application by EARN.MALLORY (Nova Science Publication)

DEPE – 14905 Material Handling & Plant Layout

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction to plant design:** types of manufacturing processes. Plant Location, influence of location on layout. Industrial buildings, influence of building on layout. Classical types of layout - product layout and practical layout.
2. **Planning the layout** - collecting of data for determining and diagramming - the flow of material, visualizing possible layout and evaluating alternative layouts. Storage, plant servicing and office layout. Line balancing - various operational research techniques for balancing of assembly lines fabrication lines balancing.
3. **Safety Engg.** - Safety in various shops, safety in critical storage area, storage explosive material, gases and inflammable liquids.
4. **Importance of materials handling:** Principles of material handling, analysis of material handling problem, operation and flow process charts, flow diagrams.
5. **Material handling factors:** Materials, containers frequency and duration, distance, speed, environment labour and equipment.
6. **Factory planning and material handling:** Plant location factory handling, the layout as key materials handling problem.
7. **Production Control and materials handling:** Types of Production Control, material control. Production planning, production scheduling, production dispatching ;and follow up as related to materials handling. Material Handling Equipment: Belt Carrier, chain and cable roller,
8. **Screw vibrating and reciprocating:** pneumatic tubes, load transferring, machines, air operated ;and hydraulic devices.
9. **Cranes:** Elevators and Hoists; Industrial Trucks, dump trucks, overhead trackage system. Pallets and containers.

Books Recommended:

1. J.M. Apple, "Plant Layout and Material handling", Rjonald Press.
2. J.M. Moore, "Plant Layout and Design", MacMillan and Co.
3. R. Mutter, "Systematic Layout Planning", Cahners Books
4. A.B. Chowdhary, "Plant Layout & Material handling", Khanna Publishers.
5. Fred e. Meyers, "Material handling & plant layout", prentice hall,

DEPE-14906 Supply Chain Management

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Introduction: Objectives of supply chain Management, key components of supply chain i.e. sourcing, distribution strategy, customer service strategy; supply chain Management as Integrated logistics, generic activities, architecture of supply chain, future potential of supply chain Management.

Corporate Profitability: Link to supply chain, evaluation of SCM strategies, customer focus in SCM, inventory and logistic Management, vendor Management, just-in-time (JIT).

Quality Management: Inherent link to SCM: Suppliers development, distribution channel, re-engineering of supply chain, IT – enabled supply chain: Electronic data interchange, enterprise resource planning, implementation of IT, Scope of emerging distributed cooperative tele manufacturing over internet.

Organizational Issues: Application of knowledge Management for effectiveness SCM, social interactions and linking of functional units in a supply chain, Combined core

competency of SC : Global sourcing, technology and tools – essential enablers, framework for managing a knowledge intensive supply chain.

Recent Trends in SCM: Tierisation of supplies, Reverse logistics, JIT II, Milk Round System (MRS), bar coding, Hub and Spoke Concept and other latest concepts.

Recommended Books:

1. . Chopra, Supply Chain Management, Pearson Education Asia, New Delhi
2. Christopher, Logistics and Supply Chain Management, 2/E, Pearson Education Asia, New Delhi
3. Taylor & Brunt, Manufacturing Operations and Supply Chain Management (The Lean Approach), Business Press Thomson Learning N.York.
4. Arjan J. Van Weele, Purchasing and Supply Chain Management (Analysis Planning and Practice), 2/Engineering, Business Press, Thomson Learning N.York.
5. Donald Bowersox, Logistic Management - The Integrated Supply Chain process, McGraw Hill, N.York

DEPE-14907 Applied Elasticity and Plasticity

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Theory of Elasticity**-Analysis of stress and strain, equilibrium, Compatibility and constitutive equations, Planestress and plane strain problems, General equation in Polar co-ordinates, Rotating discs and stresses in circular discs, Stress function in terms of harmonic and complex functions, Equation of equilibrium of a deformed body in curvilinear coordinates, Principle of superposition and principle of virtual work, Torsion of thin tubes, Bending of cantilevers, Uniformly and continuous loaded beams, Bending of circular, elliptical and rectangular cross-section bars, Axisymmetric formulation and deformation of solids of revolution.
2. **Theory of Plasticity**-Nature of engineering plasticity, Differentialequations of equilibrium, 3D stress analysis, infinitesimal deformation, finite deformation, Von Mises', Tresca's and anisotropic yield criteria, Halgh-Westergard stress space representation of yield criteria, experimental verification of yield criteria, Subsequent yield surfaces. Elastic and plastic stress-strain relations and stress strain rate equations, Prandtl-Reuss equations, Generalized plastic stress strain relations, Anisotropy and instability. Plane plastic flow, Slip-line field theory, Application of slip line field theory to plane strain metal forming processes. Plane plastic stress and pseudo plane stress analysis and its applications, Extremum principle for rigid perfectly plastic material, surfaces of stress and velocity discontinuity. Upper bound and lower bound theorems and applications.

Books Recommended:

1. A I Lurie ; Theory of Elasticity (Foundations of Engineering Mechanics)
2. Gladwell G M Kluwer ; Contact Problems in the Classical Theory of Elasticity; Aca
3. Chakrabarty J., Applied Plasticity; Springer-Verlag
4. R. Hill ; The Mathematical Theory of Plasticity, Oxford University.

DEPE - 14908 PRODUCTIVITY MANAGEMENT

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction:** Definition of Productivity, Productivity and performance, production, benefit cycle, Industrial productivity, scope of productivity management, factors affecting productivity, different approaches to productivity.
2. **Productivity Measurement:** Need of productivity measurement, productivity measurement approaches, total & partial productivity, productivity measurement models and their comparison, productivity measurement parameters, productivity measurement indices, work study and productivity.
3. **Productivity Planning:** Causes for productivity changes, productivity models, applications of different planning models, productivity planning executives and their responsibilities.
4. **Productivity Evaluation:** Productivity evaluation, productivity evaluation models, evaluation tree model, successive, time period models, applications of different evaluation models, role of evaluating executives and their responsibilities.
5. **Productivity Improvement:** Causes of poor productivity, remedies of poor productivity, methods to improve productivity, design of productivity improvement programs.
6. **Dynamic Programming Of Productivity Problems:** Static and dynamic causes of lower productivity, optimization of productivity.

Books Recommended:-

1. Hassan M.Z.P., "Productivity Models", A&N Printing, Chicago
2. Goodwin H.F., "Improvement in Productivity", Wiley, New York
3. Prem Vrat, "Productivity Management", Narosa Publishing House, New Delhi.
4. David J. Sumanth, "Productivity Engg. & Management", TMH, New Delhi
5. Mali. P., "Improving Total Productivity", Wiley, New York

Group-II

DEPE – 14909 Marketing & Financial Management

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Marketing Management:** Definition of Marketing & its Scope, marketing Vs Selling Consumer Vs Industrial Marketing, Marketing Mix, Strategic planning. Marketing Management concept, Marketing Research Process & Techniques of Marketing Research. Consumer Behavior Factor affecting Consumer Behavior and Buying Processes. Market Segmentation - Bases for Segmenting Consumer and Industrial Segments. Product Mix, Product life cycle and ;Marketing Strategies in various stages of PLC,
2. **Pricing decisions:** Price Setting Procedure and various Methods of pricing. Nature of Marketing Channels in Consumer, Industrial and Service Sectors, Channel Design Decisions, Promotion Mix and Nature of each Promotional
3. **Financial Management:** Nature, Scope and objectives of Financial Management. Investment Decision Making and Capital Budgeting Techniques - Pay Back Method. Average Rate of Return Method, Net Present Value method. Sources of Long Term and Short Term Funds, Lease Financing. Working Capital Management- Concept Factors affecting Working Capital Needs. Cost of Capital - Equity, Preference Share Capital and Debt. Ratio Analysis

Books Recommended

1. Philip Kotler, "Marketing, Management", Pearson prentice Hall
2. Financial Management. I.M.Panday.
3. Ramaswamy & Namakumari, "Marketing Management", Macmillan,
4. J.C. Gandhi, "Marketing Management", Macmillan Publishers India ltd
5. Prasanna Chandra, " Financial Management", Tata McGraw

DEPE – 14910 Modeling and Simulation

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

- 1. Modeling** Need for system modeling, systems approach to modeling, open and feed back systems, combination of simple feed back systems, feed back time lag effects, feed back and managerial systems, Principle of analytical modeling, kinds of analytical methods, measures of effectiveness, cost analysis of large systems
- 2. Simulation:** Monte Carlo simulation, generation of stochastic variates, continuous and discrete probability distributions, application of Monte Carlo methods for production systems, computer simulation models, Macro Dynamic models, examples from business and industry, design of management game, Simulation languages SIMULA, SIMSCRIPT, GPSS etc. Statistical output analysis
- 3. Analog computer simulation:** basic analog computer components and operations; amplitude and time scaling; solution of linear and non-linear partial differential equations, formulation of model for a dynamic system and its simulation on analog computer

Books Recommended:

1. DeoNarsingh, "System Simulation with Digital Computer", PHI
2. Gordon, "System Simulation", PHI
3. Jackson A.S., "Analog Computation", McGraw hill
4. Naylor T.H., "Computer Simulation Techniques", John wiley
5. Buffa, "Modern Production Management", Wiley

DEPE – 14911 Estimating and Costing**Internal Marks: 40****LTP****External Marks: 60****400****Total Marks: 100**

- 1. Financial Management & Ratio analysis:** Financial Functions, Scope, goals and tools. Sources of finance. Ratio analysis – important ratios, their utility and limitations. Turnover Ratios, Profitability Ratios.
- 2. Classification of Costs:** Methods of costing and elements of cost. Prime Cost, Cost of production, Overheads; Material cost, labour Cost, Expenses. Different methods of pricing of issue of materials. Wages and incentive plans. Principles of good remunerating system, labour turnover. Depreciation – concept, importance and different methods of depreciation Estimating of Material, Machining, labour and overheads costs.
- 3. Overheads, standard Costing & Marginal Costing:** Classification, collection of overheads, Primary and secondary apportionment of overheads, absorption of overheads- Machine hour and labour hour rate. Under and over absorption of overheads. Standard costing – concept, development and use of standard costing, variance analysis. Marginal costing – Use of marginal Costing in decision – making.
- 4. Capital Budgeting:** Control of Capital Expenditure, Evaluation process- payback approach, IRR, present value method. Replacement cost and other models: introduction, models including discounted cash flow.
- 5. Budgetary control and variance Analysis:** Material, Labour, Overhead, sales. Profit, Product-mix and yield Variance. Capital cost control- the nature of control, elements of cost control programme, project planning and scheduling, cost reporting and corrective action. Capital cost control- repetitive operating cost , standard costs, cost reporting and corrective action.
- 6. Import and Import substitution:** Factors affecting national and international markets, Import procedure and documents (Bill of loading, Letter of Credit etc.) current EXIM policies, Import substitution E-Procurement
- 7. Pricing and Decision Process:** Opportunity cost relevance and contribution approach; incremental cost; ROI; strategic pricing of new product, full cost pricing- advantages & disadvantages.

Books Recommended:

1. Henry M. Steiner, "Engineering Economics Principles", McGraw Hill Publication.
2. N.K. Parsad "Principles and Practice of Cost Accounting", Book Syndicate Pvt. Ltd. Calcutta 700009.
3. Jawahar Lal , "Cost Accounting", 3rd Edition, Tata McGraw Hill Publication, New Delhi.

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

Concept of value, cost and price, customer and value, philosophy and objectives of value analysis, types of value, areas of application of value engineering, limitations of value analysis, difference between value engineering and cost reduction techniques; Tool of technology in value analysis, method & engineering, cause and effect diagram, SWOT analysis, break even analysis, system approach; Job plan for value analysis approach: Information Phase, Function Phase, Creation Phase, Evaluation Phase, Recommendation Phase, Implementation Phase, Audit Phase; Value Engineering Cell, Value Manual, composition of cell, cost cutting, various cost cutting techniques; Case studies in value engineering and analysis from manufacturing and service industries.

Recommended Books:

1. Mudge, Value Engineering, SAVE, N.York
2. Miles Lawrence, Techniques of value analysis and value engineering,
3. McGraw Hill, N.York
4. ASME, Value Engineering in Manufacturing, Prentice Hall India, N.Delhi
5. Getting More at less Cost Value Engg. Tata McGraw Hill, N.Delhi
6. Parker, D.E. Value Engg. Theory, L.D. Miles Value Foundation, N.York

DEPE- 14913 Automobile Engineering

Internal Marks: 40

LTP

External Marks: 60
Total Marks: 100

400

1. **Introduction** - Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit.
2. **Power Unit** - Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system, silencers, types of pistons and rings
3. **Fuel Supply System** - Air cleaner and fuel pumps; Air fuel requirements and carburization; constructional details of Carter carburetors and fuel injection systems; MPFI (Petrol), Diesel fuel system - cleaning, injection pump, injector and nozzles, Common Rail fuel supply system
4. **Lubrication and Cooling Systems** -Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crankcase ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.
5. **Chassis and Suspension** -Loads on the frame, considerations of strength and stiffness, engine mounting, independent suspension systems (Mac Pherson, Trailing Links, Wishbone), shock absorbers and stabilizers; wheels and tyres, tyre wear types, constructional details of plies
6. **Transmission system** -Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel v/s front wheel drive, principle of automatic transmission
7. **Steering System** -Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering, Ball re-circulating mechanism
8. **Braking System** -General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances
9. **Electric System** -Classification, Introduction to Conventional and transistorized ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements: voltage and current regulation
10. **Maintenance** -Preventive maintenance, trouble shooting and rectification in different systems; engine tuning and servicing, major tools used for maintenance of automobiles

Books Recommended

1. W.H Crouse, Automotive mechanics, McGraw Hill
2. J. Heitner, Automotive Mechanics, East West Press
3. Kirpal Singh, Automobile Engineering Vol. I and II, Standard Publishers
4. J. Webster, Auto Mechanics, Glencoe Publishing Co.
5. P.S Gill, Automobile Engineering, S.K Kataria

DEPE – 14914 Production Planning and Control

Internal Marks: 40

LTP

External Marks: 60
Total Marks: 100

400

1. **Necessity of planning and control:** functions of production control dept. Factors determining control procedure. Types of controls. Forecasting: Importance of forecasting, fields for forecasting : techniques for forecasting sales, conventional and statistical techniques, Regression or Co-relation analysis, short term and long term trends in business, forecasting demand for spare parts, stock forecast.
2. **Planning: Adjustments in forecasting,** planning for making and buying. Types of plans: mathematical planning techniques, quantity standards , frequency standards, financial aspects of planning, analysis of machine capacity, planning for labour.
3. **Production Control:**Routing, definition, routing procedures including bill of materials, route file, routing for two or more items, standard route charts, recent techniques of routing. Progress reporting and expediting methods.
4. **Scheduling:**Master schedule, departmental and shop schedule charts for scheduling. Gantt Charts- loading and scheduling, Sched-U-Graph. Boards for scheduling.

5. Dispatching:

Procedure, types, bulletin boards, plant departmental and shop bulletin boards, material requisition identifications tag. Move ticket, operation tickets, machine control boards. Inspection ticket, Time ticket, communication systems for dispatching, follow up.

6. Inventory control:

Importance of inventory control, purchases & inventory control, factors which affect stocks, methods of inventory control. Budgetary and trend, stock taking, physical, perpetual and running inventories. Ordering quantity to order.

7. Store-Room Operations:

Location and layout of store-room bins, pans and boxes used for storing, books and documents used in storing, decentralized stores, inspections function of store.

8. Purchasing:

Planning for purchasing, procurement schedule, purchase requisition, calling tenders, comparative statements, placing order, receiving materials, inspection, entry and payment. Foreign purchases - Imports. Documents and books used in purchasing.

9. **Computer Applications:** Application of computers in production planning and control activities. Material Requirement Planning (MRP) , Manufacturing Resource Planning (MRP II) .

Books Recommended:

1. F. G. Moore , “Production Management”, Richard D. Irwin
2. John F. Biegel , “Production controls”,Prentic Hall
3. K. C. Jain & N. L. Aggarwal, “Production Planning Control & Industrial Management.” Khanna Publishers
4. J. G. Monks, “Production / Operations Management”, McGraw-Hill
5. Elwood Spencer Buffa , “Modern Production Management”, Wiley/Hamilton

DEPE - 14915 Jigs, Fixtures and Tool Design

Internal Marks: 40

LTP

External Marks: 60
Total Marks: 100

400

1. **Introduction:** Definition; importance of process planning for jigs, fixtures and tool design; selection and sequence of operations, machines, tools/die sets, gauges etc.; process planning sheet; case study.
2. **Jigs & Fixtures:** Definition; classification of jigs and fixtures; When a Jig or a Fixture is needed, Principles of economics of Jigs and Fixtures; design considerations for location, clamping and guiding devices; selection of Jigs / Fixtures. Design of Drill Jigs, Milling Fixtures, Lathe Fixtures, Assembly Fixtures, Welding fixtures, Inspection fixtures, Broaching Fixtures; Hydraulic, Pneumatic and Magnetic devices for clamping; Actual design problems.
3. **Press Tool Design:** Types of Presses and selection, Press accessories and attachments; Chutes, Magazines, Hoppers, Roll feeds, Dials. Automatic stops, hand feed and pin stops; Development of blanks and scrap strip layouts; Types of Die sets, Selection between Dies; Die materials; Design considerations for Dies, actual design problems of Blanking dies, Piercing dies, Combination dies, Progressive dies, Bending dies; Design considerations for Forming and Forging dies, Trimming dies.

Books Recommended:

1. Edward G. Hoffman, "Jig and fixture Design", Delmercengagelearning
2. C. Elanchezhian, T. Sunder Selwyn, B. VijayaRamnath, "Design of *Jigs, Fixtures and Press Tools*", Eswar Press
3. Joshi, "Jigs And Fixtures", TataMcGraw-Hill
4. Fred Herbert Colvin, Lucian Levant Haas, "Jigs and Fixtures", BiblioBazaar
5. Hiram E. Grant, "Jigs and Fixtures Non-standard Clamping Devices", TataMcGraw-Hill.

DEPE-14916 Industrial Safety and Environment

Internal Marks: 40
External Marks: 60

LTP
400

Total Marks: 100

1. **Safety:** Measuring and need for safety. Relationship of safety with plant design, equipment design and work environment. Industrial accidents, their nature, types and causes. Assessment of accident costs; prevention of accidents. Industrial hazards, Hazards identification techniques, accident investigation, reporting and analysis.
2. **Planning for safety:** Definition, purpose, nature scope and procedure. Range of planning, variety of plans. Policy formulation and implementation safety policies. Safety measures in a manufacturing organization, safety and economics, safety and productivity. Employees participation in safety. Safety standards and legislation.
3. **Meaning of environment and need for environmental control:** Environmental factors in industry. Effect of temperature, Illumination, humidity noise and vibrations on human body and mind. Measurement and mitigation of physical and mental fatigue. Basics of environmental design for improved efficiency and accuracy at work
4. **Ventilation and heat control:** Purpose of ventilation. Physiology of heat regulation. Thermal environment and its measurement . Thermal comfort . Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning process ventilation Control of radiant heat, dilution ventilation. Local relief.
5. **Industrial Lighting:** Purpose of lighting, benefits of good illumination , Phenomenon of lighting and safety, Lighting and the work source and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Maintenance standard relating to lighting and colour.
6. **Noise and Vibrations:** Continuous and impulse noise. The effect of noise on man. Noise measurement and evaluation of noise. Noise isolation. Noise absorption techniques. Silencers. Vibrations; Effect, Measurement and control measures. Environment standard; Introduction to ISO 14000; Environmental standard for representative industries.

Books Recommended:

- 1., Rjossamo, “Air Pollution Control”, McGraw Hill. .
2. Joselin, “Ventilation”, Edward Arnold.
3. Beranek, “Noise Reduction”, McGraw Hill.
4. DC Reamer, R , “Modern Safety & Health Technology”, Wiley.
5. Heinrich, H.W., “Industrial Accident prevention”, McGraw Hill.

DEPE - 14917 MECHATRONICS

Internal Marks: 40
External Marks: 60

LTP
400

Total Marks: 100

Introduction to Mechatronics Systems: Measurement Systems-Control Systems-Mechatronics approach Sensors and transducers: Introduction-Performance Terminology-Displacement, Position and Proximity-Velocity and Motion-Fluid Pressure-Temperature Sensor-Light Sensor-Selection of Sensor-Signal processing

Microprocessor: Introduction-Architecture-Pin Configuration-Instruction set-Programming of Microprocessors using 8085 instructions-interfacing- Input & Output devices-Interfacing D/A converts & A/D converters-application-temperature control stepper motor control-Traffic light controller. Programmable Processing Programming-Mnemonics- Timers internal relays & counter data Handling-Analog Input-Output Sections of a PLC.

Design & Mechatronics: Stages in Designingmechatronics system, Traditional & Mechatronics design, Possible design solution, case studies of mechatronic systems, Pick & place robot, automatic car park system, engine management system.

Books Recommended

1. Bolton W.,” Mechatronics”,Longman, Second Edition,2004.
2. Histan Micheal B. &Alciatore David G.,”introduction to Mechatronics & Measurement Systems”,McGraw Hill Inrenational Edition, 2003.
3. HMT Ltd., “Mechatronics”, Tata McGraw Hill publishing Co. Ltd., 1998.
4. Bradley D.A., Dawson D., Buru N.C. & Loader A.J., “Mechatronics”, Chapman & Hall, 1993.
5. Gaonkar Ramesh S., “Microprocessor Architecture, Programming &Applications”,Wiley Eastern, 1997

Group-III

DEPE - 14918 Maintenance and Reliability Engineering

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction:** Objective and characteristics of maintenance function; Organization of the maintenance system; Operating practices in maintenance. Maintenance record keeping.
2. **Cost Aspect of Maintenance:** Costs of machine breakdown; estimation of life cycle costs; Application of work measurement in maintenance; Manpower planning and training, Incentive payments for maintenance
3. **Planning of Maintenance Activities:** Evaluation of alternative maintenance policies breakdown, preventive and predictive maintenance; fault diagnosis and condition monitoring techniques; simulation of alternative practices; Development of preventive maintenance schedule; House keeping practices; total productive maintenance
4. **Maintenance Engineering:** Maintenance requirements of mechanical, electrical, process and service equipment; Safety aspect in maintenance; Aspect of lubrication; chemical control of corrosion; Computerized maintenance information systems
5. **Reliability concept and definition:-** configuration of failure data, various terms used in failure data analysis in mathematical forms, component and system failures,; uses of reliability concepts in design and maintenance of different system.
6. **Reliability and Availability of Engineering systems:** Quantitative estimation of
7. **Reliability of parts;** Reliability of parallel and series elements; Accuracy and confidence of reliability estimation; Statistical estimation of reliability indices; Machine failure pattern; Breakdown time distribution
8. **Reliability improvement:-** Reliability in design, reliability in engg, systems, systems with spares, reliability simulation, redundant and stand by systems, confidence levels, component improvement element, unit and standby redundancy optimization and reliability-cost trade off. Fault Tree Analysis: Introduction and importance, fault tree construction, reliability calculations from fault tree, tie set and cut set methods, event tree and numerical problems.

Books Recommended:-

1. Higgins LR, "Maintenance Engineering Handbook ", McGraw Hill
2. Clifton, RH, "Principles of Planned Maintenance", ArnoldLodon
3. Garg HP, "Industrial Maintenance", S. Chand and Co
4. A Kelly , "Maintenance planning control ", (Indian ED)
5. S.K Sinha, "Reliability Engg", Wiley Eastern.

DEPE-14919 Quality Assurance And Reliability

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction**-Definition of Quality, Quality function, Dimensions of Quality, Quality. Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems. Introduction to Quality function deployment.
2. **Quality Assurance**-Definition and concept of quality assurance ,departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing, audit activities, audit reporting, ingredients of a quality program.
3. **Statistical Process Control**-Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC.
4. **Process capability** –Basic definition, standardized formula, relation to product tolerance and six sigma concept of process capability, Seven QC tools.
5. **Control Charts for Variables**-Controls charts for X bar and Range \bar{X} and R charts, statistical basis of the charts, development and use of \bar{X} bar and R charts interpretation of charts. Control charts for X bar and standard deviation (S), development and use of \bar{X} bar and S chart. Brief discussion on –Pre control \bar{X} bar and S control charts with variable sample size, control charts for individual measurements, moving-range charts.
6. **Control Charts for Attributes**-Controls chart for fraction non-conforming (defectives) development and operation of control chart, brief discussion on variable sample size. Control chart for non-conformities (defects) –development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Guidelines for implementing control charts.
7. **Sampling Inspection**-Concept of accepting sampling, economics of inspection, Acceptance plans –single, double and multiple sampling. Operating characteristic curves –construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans, Gauge R and R and MSA.
8. **Statistical Theory of Tolerances**-Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas.

- 9. Reliability and Life Testing**-Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations.

Books Recommended:

1. D C Montgomery ;Introduction to statistical Quality Control , John Wiley and Sons.
2. J M Juran, Frank M Gryna ;Quality Planning & Analysis; Tata McGraw Hill,
3. NVR Naidu, KM Babu and G. Rajendra; Total Quality Management; New Age International Pvt.
4. Grant and Leavenworth ; Statistical Quality Control, McGraw Hill,
5. Janet L Novak and Kathleen C Bosheers;The QS9000 Documentation Toolkit,” Prentice Hall PTR,
6. Suresh Dalela and Saurabh ;ISO 9000 a Manual for Total Quality Management, S. Chand Co.
7. KesavanR;Total Quality Management -, I.K. International

External Marks: 60
Total Marks: 100

400

1. **Quality and Total Quality Management;** Excellence in manufacturing/service, factors of excellence, relevance of TQM.
2. **Concept and definition of quality;** total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.
3. **Just-in-time (JIT):** Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
4. **Customer:** Satisfaction, data collection and complaint, redressal mechanism.
5. **Planning Process:** Policy development and implementation; plan formulation and implementation.
6. **Process Management:** Factors affecting process management, Quality function development (QFD), and quality assurance system.
7. **Total Employees Involvement (TEI):** Empowering employees: team building; quality circles; reward and Recognition; education and training, Suggestion schemes.
8. **Problems solving Defining problem;** Problem identification and solving process; QC tools.
9. **Benchmarking definition,** concept, process and types of benchmarking.
10. **Quality Systems:** Concept of quality system standards: relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.
11. **Advanced techniques of TQM:** Design of experiments: failure mode effect analysis: Taguchi methods

Books Recommended:

1. sunder Raju, "Total Quality Management by", Tata Mcgraw Hill
2. M.Zairi, "TQM for engineers ", Aditya Books
3. J.L. Hradeskym, "Total Quality Management Handbook ", MCGraw Hill
4. Dalela and Saurabh, "ISO 9000 quality System ", standard Publishers
5. Dr. Susan Perry, "*Total Quality Management*", St Lucie Press

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction** Meaning, definition, functions of materials management, Concept of integrated material management, Relationship of material management with other Organizational functions.
2. **Material Planning & Budgeting:** Need for material planning, Factors affecting material planning, Techniques of material planning; Material classification, codification and standardization; Material budgeting - meaning and need, techniques of material budgeting.
3. **Inventory Control:** Need and meaning of inventory, types of inventory, functions of inventory control, Inventory costs, Inventory control tool - ABC, VED, XYZ and FSN: Economic order Quantity and replenishment of stocks. Physical control of inventory: Fixed order, Two bin and Kardex systems - Material requirement planning (MRP-I) Spare parts control for maintenance purposes. Evaluation of inventory control performance. Concept of Just-in-Time(JIT). Use of computers for inventory control
4. **Purchasing:** Purchasing principles, procedures and systems, Functions of purchasing, Make-or-buy decision, Vendor development and vendor rating. Factors affecting purchase decisions, Legal aspects of purchasing, Documentation and procedure for import.
5. **Storage:** Functions and importance of store keeping, types of stores, store accounting and store verification, Legal aspects of store keeping, Management of surplus, scrap and obsolete items. Importance of material handling in store keeping, handling equipment.

Books Recommended

1. M.M Verma , “Materials Management “,S. Chand and Sons
2. gopal Krishnan and sundaresan, “Material Management - An Integrated Approach “,; Prentice Hall
3. Dobbler and Burt, “Purchasing and materials management”, Tata McGraw Hill
4. PawanArora, “ Material Management”,Globalindia Publications Ltd
5. Rajendra Mishra, “ Material Management”,Excel Books

DEPE – 14922 Project Management

Internal Marks: 40

LTP

External Marks: 60
Total Marks: 100

400

1. **Introduction:** Concept of a project, types of project, project life cycle phase, project development, project identification and selection, feasibility study.
2. **Project Management:** functions, comparison with traditional management, forms for project management in industry and service sector
3. **Project Planning:** Work Breakdown structure, project execution planning, contract planning. Work planning and organization planning, matrix organization, task force organization and totally project based organization systems and procedure planning.
4. **Project Scheduling:** Gantt Charts, Network Scheduling, PE - RT and CPM, Worked examples of PE - RT and CPM.
5. **Project Monitoring:** Line of Balanced and Pace (Performance and Cost Evaluation) techniques.
6. **Project Control:** Project control process, performance analysis, internal and external project control, approaches to project control, control problems.
7. **Human Aspects Of Project Management:** Leadership in project management, the role of project manager, project team, motivation and group cohesiveness.

Books Recommended:

1. S. Choudhary, "Project Management", Tata McGraw Hill.
2. Nicholas, "Managing Business and Engineering Projects", Prentice Hall.
3. Prasanna Chandra, "Project Preparation Appraisal, Budgeting and Implementatipon", Tata McGraw Hill.
4. Mike Field, Laurie S. Keller, "Project Management", Thomsan Learning
5. SadhanChoudhury, "Project Management", Tata McGraw Hill

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

- 1. Introduction To Finance:** Evolution of finance objective of the firm. time value of money present values, internal rate of return or yield bond returns. The return from a stock investment, dividend discount models.
- 2. Market Risks & Returns:** Efficient financial market security portfolios. multiple security portfolio analysis and selection, capital asset pricing model, expected returns for individual security.
- 3. Financial Planning:** Importance of financial steps factors, limitations, concept of capital; and its management, fund flow and Cash flow analysis.
- 4. Project Identification & Evaluation:** Search for a business idea, project identification project planning, project appraisal, project evaluation under risk. under uncertainly, analysis of non-financial aspects.
- 5. Investment Analysis:** Introduction to investment analysis, discounted cash flow criteria for economic evaluation-ROL_ payback, MAP equipment selection, risk analysis, break even point, capacity planning. portfolio selection and technological forecasting.
- 6. Capital Investment:** Principles of capital investment. Methods of evaluation, Depreciation and other refinements in Cash flow information, inflation and capital budgeting, risks in capital budgeting required returns for companies and acquisitions.

Books Recommended:

1. J.M.Pandey, "Financial Management", Vikas Publishing
2. James Van Home, "Financial Management & Policy", Prentice Hall International
3. Harold Kerzner, "Project Management", John Willy and sons
4. Prasanna Chandra, "Financial Management", Tata McGraw Hill
5. Geoffrey Hirt, Stanley Block, Somnath Basu, "Investment Planning",

DEPE – 14924 Entrepreneurship

Internal Marks: 40
External Marks: 60

LTP
400

Total Marks: 100**1. Concept of entrepreneurship:**

Entrepreneurship and small-scale industry, need for promotion of entrepreneurship, entrepreneurship development programs (EDP), personality characteristics of entrepreneur.

2. Identification Of :Investment Opportunities:

Governmental regulatory framework, industrial policy, industrial development and regulation act, regulation of foreign collaboration and investment, foreign exchange regulation act, incentives for export oriented units, incentives for units in industrially backward areas, incentives for small scale industry, government assistance to SSI, how to start and SSI, list of items reserved for SSI, Scouting for project ideas, preliminary screening, project identification for an existing company.

3. Market and Demand Analysis:

Information required for market and demand analysis, market survey, demand forecasting, uncertainties demand forecasting.

4. Cost of Project and Means Of Financing:

Cost of project, means of financing, planning the capital structure of a new company, term loan financial institutions, cost of production.

5. Financial Management:

Concept and definition of financial management types of capital, of finance, reserve and surplus, concepts and liabilities, profit and loss statement balance sheet, depreciation, methods of calculating depreciation break even analysis and

Books Recommended:

1. A. Saxena, "*Entrepreneurship*", Mayur Enterprises
2. Project Preparation, Appraisal Budgeting and Implementation, Prasannachandra, TMH.
3. Wojciech W Gasparski, "*Entrepreneurship*", Transaction Published, New Brunswick
4. Donald F. Kuratko, "*Entrepreneurship*", south western cengage learning
5. D.D. Sharma, J.S. Saini, "*Entrepreneurship Development in Hosiery Industry*", northern book centre

DEPE - 14925 Inspection & Quality Control**Internal Marks: 40****External Marks: 60****LTP****400**

Total Marks: 100

Course objectives (C Obj.): The course of Inspection and quality control gives

1. Practical application is of virtual importance in the modern competitive industrial environment.
2. The subject gives sound knowledge of inspection, quality, quality assurance, quality control and various quality management systems to the students.

Course outcomes (CO): The study of this subject equips students with

1. The knowledge of various aspects quality, quality control, and Inspection and quality management systems.
2. The students are able to apply various quality controls tools in the industries to enhance the quality.

Detailed Contents**1. Quality**

Concept of Quality, Quality Function, Quality Traits, Quality Characteristics, Quality Management, Quality Principles, Quality Policy, Quality System, Quality Planning, Organizing for Quality, Quality of Design, Quality Circles, Total Quality Management

2. Quality Costs

Quality Costs, Cost of Prevention, Cost of Appraisal, Cost of Internal Failure, Cost of External Failure, Value of Quality, Quality Cost Model, Cost Analysis in Design, Cost Reduction through Quality Improvement.

3. Inspection

Definition of Inspection, Inspection Planning, Measurement Errors, Objectives of Inspection, Floor / Patrol Inspection, Centralized Inspection, Process Inspection, Final Inspection, Difference between Inspection & Quality Control.

4. Quality Assurance

Importance, Total Quality Assurance, Management Principles in Quality Assurance, Forms of Quality Assurance, Evaluation of Quality Assurance, Quality Assurance Programme, Quality Assurance Aspects, Quality Assurance Departments.

5. Quality Control

Total Quality Control, Objectives of Quality Control, Principles of Quality Control, Quality Control Tools, Statistical Quality Control, Control Charts, Construction of Control Charts for Variables (X – R, X - Chart) and Attributes (p, np, C, U Charts), Acceptance Sampling by Attributes, AOQ & OC Curves, Types of Sampling Plans, Analysis of Process Capability, Use of Dodge Roaming and Military Standards Sampling Tables.

6. Quality Management System

Quality Management systems- origin of ISO 9000 series (ISO 9001,9002,9003,9004) ISO 9001:2000, clauses of ISO 9001:2000, overview of

QS 9000 series

Books Recommended:-

1. M. Mahajan, "SQC", DhanpatRai& Sons
2. Grant E.L. & Leavenworth, R.S., "SQC", McGraw-Hill
3. J.M. Juran, E.N. Gryna Jr., "Quality Planning & Analysis", McGraw-Hill
4. Dr. K.C. Arora, "TQM & ISO 14000", S.K. Kataria& Sons
5. J.M. Juran, "Quality Control Handbook", McGraw-Hill

DEPE-14926 CAD& Computer Graphics

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Introduction** -Need and Scope of Computer Aided Design,Fundamental of CAD and computer graphics-Application areas, Hardware and software-overview of graphics systems, video-display devices, and raster – scansystems, random scan systems, graphics monitors and workstations and input devices. Interactive hardware/software techniques, Drawing standards, dimensioning and text writing, concept of layers, advanced concepts of CADsoftware-blocks, UCS, 3D-line, 3D object, DXF & DXB file formats. Output primitives-Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives Scan line polygon fill algorithm, boundary fill and flood-fill algorithms.
2. **2D geometrical transforms**-Translation, scaling, rotation, reflection and shear transformations. Matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems. 2D viewing-The viewing pipeline, viewing coordinate reference frame. Window to view port coordinate transformation, viewing functions. Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygonclipping algorithm.
3. **3D Object Representation**-Polygon surfaces, quadric surfaces, spline representation. Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon-rendering methods. 3D viewing-Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.
4. **3D Geometric transformations**-Translation, rotation, scaling, reflection and shear transformations, composite transformations. Visible surface detection methods-Classification, back-face detection, depth buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods.
5. **Finite Element Method**-Numerical Methods-Introduction, Errors in numbers, Root finding-Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation – Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method. Introduction to the principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element), solution of finite element equation-higher order and iso-parametric elements, equilibrium problems in structural mechanics, Eigen value problems.
6. **Introduction to CAD CAM**-Overview, orientation and application commands of CAD and CAE modeling software platforms for feature based Parametric and Variation modeling and analysis. Boolean, and sweep operations on primitives with applications to CAD of machine elements.

Books Recommended:

1. McConnell, J. J. Computer graphics theory into practice Jones and Bartlett Publishers.
2. Davis, M. J. Computer Graphics Nova Science Pub Inc.

3. Rogers, D. F., Earnshaw, R. A., Graphics, B. C. S. C., Group, D., & Society, C. G. Computer graphics techniques theory and practice Springer-Verlag.
4. Salomon, D. Transformations and projections in computer graphics Springer.
5. Bethune, J. D. Engineering Design and Graphics with SolidWorks Prentice Hall.
6. Zeid, I. Mastering CAD/CAM (Engineering Series) McGraw-Hill Higher Education.

Open Electives

List of Open Elective Subjects (To be offered in 6th semester):

Sr. No.	Code	Name Of Subject
1.	OEPE-14601	Operation Management
2.	OEPE-14602	Operation Research

Note:

- 1. Minimum 25 students and maximum 30 students are required to offer a Department Elective subject**

OEPE – 14601 Operations Management

Internal Marks: 40
External Marks: 60
Total Marks: 100

LTP
400

1. **Need And Scope - Of Operation Management:** Types of production system and their characteristics, productivity definition, types and measurements
2. **Product Design And Development:** Steps involved in product design and development , considerations of technical, ergonomic, aesthetic, economic and time factors. Use of concurrent engineering in product design and development. Discussion of case studies. Feasibility and locational analysis.
3. **Planning And Forecasting:** Role of market survey and market research in pre-planning, long medium and short range forecasting, objective and techniques of forecasting, smoothening and revision of forecast
4. **Production Planning:** Production planning objective and functions, Bill of material, Capacity and man power requirement planning, operation analysis and process planning, long range planning, aggregate planning; Objective, Strategies, graphical and mathematical techniques of aggregate planning, master production scheduling, MRP and MRPII Systems
5. **Production Control:** Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. Techniques of production control in job shop production, batch production and mass production systems,
6. **Material Management:** Objectives, scope and functions of material management, planning, procurement, storing, ending and inventory control. Purpose of inventory, inventory cost, inventory control systems, Selective inventory control systems, Determination of EOQ, Lead time and reorder point. Methods of physical stock control
7. **Quality Control:** Meaning of quality and quality control, quality of design, quality of conformance and quality of performance, functions of quality control. Introduction to statistical quality control-control charts and sampling plans
8. **Management Information Systems:** Introduction to MIS, Steps in designing MIS, Role of Computers in MIS
9. **Maintenance Systems:** Type of maintenance, objective of maintenance, Planned maintenance strategies, preventive maintenance, condition monitoring and total productive maintenance

Books Recommended:

1. Charry, “Production and Operation Management”, Tata-McGraw Hill
2. J.G. Monks, “ Production/Operation Management”, Tata-McGraw Hill
3. R.N. Nauhria and RajnishPrakash, “Management of systems”, Wheeler Publishing, New Delhi
4. Modern Production Management by Elwood Buffa
5. E. L. Grant and R.S. Leaven Worth, “Statistical Quality Control”, McGraw Hill

OPE - 14602 Operations Research

Internal Marks: 40

LTP

External Marks: 60

310

Total Marks: 100

Course objectives (C Obj.): This subject is used extensively in business, industry and government sector. The aim of the course is

4. To analytical use methods such as mathematical programming, simulation, queuing theory, multi criteria analysis which are helpful in assessing the various practical problems with the appropriate logical structure.
5. The subject also enhances the skill of undergraduate students in clarifying critical data elements and their role as model inputs.
6. To solve the networking problems in various projects which are time dependent

Course outcomes (CO):

At the end of this course, the students are able to

4. To access, analyze the various business, industry and defense problems on the basis of managerial decision making.
5. The students are able to structure any real-life situation into a mathematical model
6. Abstracting the essential elements so that a solution relevant to the decision maker's objective can be sought.

Detailed Contents

8. **Introduction:** Introduction, characteristics, objectives and necessity of operation research (OR), scope of OR in industry and management. Role of computers in OR, limitations of OR.
9. **Linear Programming:** Introduction to linear programming, formulation of linear programming problems, graphical solution, simplex algorithm, computational procedure in simplex, duality and its concept, application of L.P. model to product mix and production scheduling problems, limitations of linear programming.
10. **Transportation model:** Definition of transportation model, formulation and solution methods, and degeneracy in transportation problems.
11. **Assignment Model:** Definition of assignment model, comparison with transportation model, formulation and solution methods, the travelling salesman problem.
12. **Queuing Models:** Application of queuing models, characteristics of queuing models, single channel queuing theory, solution to single channel with poisson arrivals and exponential service infinite population model, Industrial applications of queuing theory.
13. **Simulation:** Concept and use of simulation, advantages and limitations of the simulation technique, generation of random numbers, Monte-Carlo simulation,

computer-aided simulation: applications in maintenance and inventory management.

- 14. PERT and CPM:** Work breakdown structure, network logic, critical path, CPM and PE - RT, slack and floats. Resources Leveling & Time cost trade off.

Books Recommended:

1. P.K. Gupta and D.S.Hira, "Operations Research", S. Chand and company
2. A.H. Taha, "Operation Research", Macmillan Publishing Company
3. W.D. Miller and M.K Starr, "Executive Decisions and operations Research", Prentice Hall Inc, Englewood Cliffs, N.J,
4. Vijay Gupta Bhushan Kumar K.K.Chawla, "Applied Operation research", Kalyani Publishers
5. Dr. R. K. Gupta, "Operations Research", Krishna publishers
6. Operation research by Manohar Mahajan (Dhanpat Rai & Co. Publisher)