

**Revised Scheme for B.Tech (Production)**  
(2004 admission batches)

**3<sup>rd</sup> SEMESTER B.Tech (Production)**

Code	Subject	L	T	P	Int	Ext	Total
PE-201	Strength of Materials	3	1	-	40	60	100
PE-203	Machine Drawing	1	-	5	40	60	100
PE-205	Thermal Engineering	3	1	-	40	60	100
PE-207	Theory of Machines	3	1	-	40	60	100
PE-209	Manufacturing Processes-1	3	0	-	40	60	100
PE-211	Industrial Organization and Management	3	-	-	40	60	100
ME-211	Strength of Materials Lab	-	-	2	30	20	50
PE-213	Thermal Engineering Lab	-	-	2	30	20	50
PE-215	Theory of Machines Lab	-	-	2	30	20	50
PE-217	Manufacturing Processes -I Lab	-	-	2	30	20	50
PE-219	* Workshop Training	-	-	-	60	40	100
	Advisory meeting			1			
	<b>Total</b>	<b>16</b>	<b>3</b>	<b>14</b>	<b>420</b>	<b>480</b>	<b>900</b>

**Total contact hours = 33**

\* Workshop Training will be imparted in the institution at the end of second semester during summer vacations for 4 weeks (six hours per day and six days a week).

**4<sup>th</sup> SEMESTER B.Tech (Production Engg.)**

Code	Subject	L	T	P	Int	Ext	Total
PE-202	Design of Machine Elements	3	1	-	40	60	100
PE-204	Fluid Mechanics & Fluid Machinery	3	1	-	40	60	100
PE-206	Manufacturing Processes-II	3	1	-	40	60	100
PE-208	Statistics and Numerical Analysis	3	1	-	40	60	100
ME-205	Engineering Materials and Metallurgy.	3	0	-	40	60	100
PE-210	Design of Machine Elements Lab	-	-	2	30	20	50
PE-212	Fluid Mechanics & Fluid Machinery Lab.	-	-	2	30	20	50
PE-214	Manufacturing Processes-II Lab.	-	-	2	30	20	50
PE-216	Statistics and Numerical Analysis Lab.	-	-	2	30	20	50
ME-213	Engineering Materials and Metallurgy Lab	-	-	2	30	20	50
	General Fitness				100		100
	Advisory meeting			1			
	<b>Total</b>	<b>15</b>	<b>4</b>	<b>11</b>	<b>450</b>	<b>400</b>	<b>850</b>

**Total Contact hours = 30**

**NOTE:-** There shall be industrial training of 06 weeks duration in reputed industries at the end of 4<sup>th</sup> semester. The marks for this will be included in the 5<sup>th</sup> semester.

**5<sup>th</sup> SEMESTER B.Tech (Production)**

2003 admission batches

	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Int</b>	<b>Ext</b>	<b>Total</b>
PE-301	Operations Research	3	1	-	40	60	100
PE-303	Machining Science	3	1	-	40	60	100
PE-305	Engg Metrology	3	1	-	40	60	100
PE-307	Metal Forming	3	1	-	40	60	100
PE-309	Inspection & Quality Control	3	1	-	40	60	100
PE-311	Jigs, fixtures and Tool Design	2	-	-	40	60	100
PE-313	Machining Science Lab	-	-	2	30	20	50
PE-315	Engg. Metrology Lab	-	-	2	30	20	50
PE-317	Metal Forming Lab	-	-	2	30	20	50
PE-319	Jigs, fixtures and Tool Design Lab	-	-	4	30	20	50
PE-321	**Industrial Training	-	-	-	60	40	100
	Advisory meeting			1			
	<b>Total</b>	<b>17</b>	<b>5</b>	<b>11</b>	<b>420</b>	<b>480</b>	<b>900</b>

**Total contact hours = 33**

\*\* Industrial Training will be imparted in the reputed Industries at the end of 4<sup>th</sup> semester of 04 weeks duration

**6<sup>th</sup> SEMESTER\* B.Tech (Production)**

<b>Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Int</b>	<b>Ext</b>	<b>Total</b>
PE-302	Industrial Engg	3	1	-	40	60	100
PE-304	Modeling and Simulation	3	1	-	40	60	100
PE-306	Product Design and Development	3	1	-	40	60	100
PE-308	Tool and Cutter Design	3	1	-	40	60	100
CE-216	Environmental science	3	1	-	40	60	100
-	Departmental Elective-I	3	1	-	40	60	100
PE-310	Industrial Engg Lab.	-	-	2	30	20	50
PE-312	Modeling and Simulation Lab	-	-	2	30	20	50
PE-314	Product Design and Development Lab	-	-	2	30	20	50
	General Fitness			-	100	-	100
	Advisory meeting			1			
	<b>Total</b>	<b>18</b>	<b>6</b>	<b>7</b>	<b>430</b>	<b>420</b>	<b>850</b>

**Total contact hours =31**

<b>7<sup>th</sup> /8<sup>th</sup> Semester*</b>					
	<b>Course Title</b>		<b>Internal</b>	<b>Ext.Viva</b>	<b>TOTAL</b>
	6-month Industrial Training		500	500	<b>1000</b>

**7<sup>th</sup> / 8<sup>th</sup> SEMESTER B.Tech (Production)**

Code	Subject	L	T	P	Int.	Ext	Total
PE-402	Computer Integrated Manufacturing	3	1	-	40	60	100
PE-404	Non -Traditional Machining	3	1	-	40	60	100
PE-406	Machine Tool Design	3	1	-	40	60	100
PE-408	Industrial Automation and Robotics	3	0	-	40	60	100
-	Departmental Elective-II	3	1	-	40	60	100
-	Open Elective	3	-	-	40	60	100
PE-414	Industrial Automation and Robotics Lab.	-	-	2	30	20	50
PE-410	Computer Integrated Manufacturing Lab	-	-	2	30	20	50
PE-412	Project	-	-	6	120	80	200
	General Fitness	-	-	-	100	-	100
	Advisory meeting			1			
	Total	18	4	11	520	480	1000

**Total Contact hours = 33**

**List of Elective Subjects:  
B.Tech (Prod)**

**Group-1**

- DE/PE-1.1 Artificial Intelligence in Manufacturing
- DE/PE-1.2 Industrial Finishing Technology
- DE/PE-1.3 Welding Technology
- DE/PE-1.4 Plastic and Ceramic Technology
- DE/ME-1.5 Non -Destructive Testing
- DE/ME-1.6 Maintenance and Reliability Engg

**Group-2**

- DE/PE-1.7 Investment Planning
- DE/PE-1.8 Technology Management
- DE/PE-1.9 Marketing and Financial management
- DE/PE-2.0 Productivity Management
- DE/ME-2.1 Operation management
- DE/ME-2.2 Total Quality Management
- DE/ME-2.3 Material Management
- DE/ME-2.4 Project Management
- DE/ME-2.5 Human Recourse management

**Group -3**

- DE/PE-2.6 Industrial Packaging
- DE/PE-2.7 Network Analysis
- DE/PE-2.8 Environmental degradation of Materials
- DE/PE-2.9 Material Handling and Plant Layout
- DE/PE-3.0 Prod. Planning and Control
- DE/ME-3.1 Industrial Safety and Environment
- DE/ME-3.2 Entrepreneurship

**Note:**

1. Minimum 10 students are required to offer a Department Elective Subject
2. The Department Elective subjects shall be offered to the students simultaneously from all the three groups (Group 1, Group 2, and Group 3). However, Deptt Elective –I (to be offered in

6<sup>th</sup> or 7<sup>th</sup> Semester) and Deptt Elective –II (to be offered in 8<sup>th</sup> Semester) should be from the same group.

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- The syllabi of DE/ME-1.5 is same as the syllabi of DE/ME-2.4.
- The syllabi of DE/ME-1.6 is same as the syllabi of DE/ME-2.6.
- The syllabi of DE/ME-2.1 is same as the syllabi of DE/ME-2.3.
- The syllabi of DE/ME-2.2 is same as the syllabi of ME-251.
- The syllabi of DE/ME-2.3 is same as the syllabi of DE/ME-2.7.
- The syllabi of DE/PE-2.4 is same as the syllabi of DE/ME-2.1
- The syllabi of DE/ME-2.5 is same as the syllabi of HU-251.
- The syllabi of DE/ME-3.1 is same as the syllabi of ME-402.
- The syllabi of DE/ME-3.2 is same as the syllabi of DE/ME-2.9.

**PE-201 STRENGTH OF MATERIALS****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100****Course Objectives****Detailed Contents**

**1. Simple stresses and strains** : Concept of stress and strain; St. Vernants 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

**2. 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:

f) Concentrated loads

g) Uniformity distributed loads over the whole span or part of span

h) Combination of concentrated loads (two or three) and uniformly distributed loads

i) Uniformity varying loads

j) Application of moments

Relation between rate of loading, shear force and bending moment

**3. 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,

**4. 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, analysis of close-coiled-helical springs.

**5. 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

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

**7. Slope and deflection** : Relationship between moment, slope and deflection, Moment area method; method 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**

1. Strength of Materials by Ferdinand P Singer and Andrew Pytel, Harper and Row H. Kogakusha Publishers, New York

2. Mechanics of Materials by SI Version, end edition by Ferdinand P. Beer and E Russel Johnston (Jr); McGraw Hill, India

3. Mechanics of Materials-SI Version 2<sup>nd</sup> Edition by EP Popov, Prentice Hall India

4. Introduction to Solid Mechanics by D.H Shames, Prentice Hall Inc.

5. Elements of strength of Materials by Timoshenko and Young
6. Strength of Materials by DS Bedi; S Chand Publisher
7. Strength of materials by R.S Lehari and A.S. Lehari, S.K Kataria and Sons.

**ME-211 STRENGTH OF MATERIALS Lab**

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

**L T P**  
**0 0 2**

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.

**PE-203 MACHINE DRAWING**

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

**L T P**  
**1 0 5**

1. Principles of drawing, requirements of production drawings, symbols of standard tolerances, machining symbols, sectioning and conventional representation, dimensioning, welding symbols, various types of screw threads.
2. 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.
3. 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.

**BOOKS:**

1. Machine Drawing, PS Gill, Kataria & Sons.
2. Machine Drawing, ND Bhatt, Charotar
3. Machine Drawing, N. Sidheswar, Tata McGraw Hill

**PE-205 THERMAL ENGINEERING**

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

**L T P**  
**3 1 0**

1. Basic Concepts: Thermodynamic system, boundary and surroundings, open, closed and isolated systems, State, property, process and cycles. Energy and its forms, Energy transfer across system boundaries, heat and work, point and path functions. Zeroth Law of thermodynamics, concept of thermal equilibrium and principle of thermometry.
2. Definition of First Law of Thermodynamics, Analytical expressions applicable to a process and cycle, Internal energy and enthalpy. Analysis of steady flow, applications of steady flow energy equation to engineering devices.
3. Open and closed system processes. Ideal Gas and characteristic gas equation. Analysis of non-flow processes for an ideal gas under constant volume (isothermal) adiabatic and polytropic conditions. Property changes. Work done and heat exchange during these processes. Free expansion and throttling processes (Description only.)
4. Second Law of Thermodynamics: Limitations of first law. Kelvin Plank and clausius statements of second law and their equivalence, their applications to a refrigerator, heat pump and heat engines, Reversible and irreversible processes, Conditions for reversibility, Efficiency and philosophy of Carnot cycle and its consequences, Carnot Theorem. Clausius inequality concept of entropy, entropy change during various processes, representations of various processes on temperature entropy plots.
5. Gas Power Cycles: air standard efficiency, piston cylinder arrangement, philosophy of Otto, Diesel and Dual combustion cycles, their compression ratios, mean effective pressure, power output and efficiency comparison between three cycles.
6. 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 and their applications.
7. Refrigeration and Air conditioning: Description of simple Vapour compression and Vapor absorption cycles, relative merits and demerits, Properties of refrigerants, Elementary idea of ozone friendly refrigerants, Concept of Psychrometry, Definitions of psychometric 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. Psychometric charts.
8. Boilers: Fire tube and water tube boilers, Description of Lancashire, Cochran, Locomotive, Babcock- Wilcox Boiler, mountings and accessories.

**BOOKS:**

1. V.P. Vasandani and D.S. Kumar, Treatise on Heat Engineering Metropolitan
2. Fundamentals of Engg. Thermodynamics by John R.Howell & Richrd O Buckius McGraw Hill International.
3. Refrigeration & Air Condition by C.P. Arora

**PE-213 THERMAL ENGINEERING LAB**

**Internal Marks: 30**

**External Marks: 20**

**Total Marks: 50**

**L T P**

**0 0 2**

1. Study of two stroke petrol engine and diesel engine models.
2. Study of four stroke diesel engine and petrol engine models.
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

**PE-207 THEORY OF MACHINES**

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

**L T P**  
**3 1 0**

1. 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.
2. Flywheels: Turning moment and crank effort diagrams for reciprocating machines Fluctuation of speed, coefficient of fluctuation of speed and energy, Determination of flywheel effect.
3. Belts, Ropes and chains: material types of drives, idler pulley, intermediate or counter shaft pulley, angle drive, 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.
4. 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.
5. 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.
6. 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:**

1. Theory of Machines PL Ballaney, Khanna Publishers
2. Theory of Machines Shigley, Mc Graw Hill
3. Theory of Machines, R.S.Khurmi, S.Chand and Sons

**PE-215 LAB THEORY OF MACHINES**

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

**L T P**  
**0 0 2**

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. Top 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.

**PE-209 MANUFACTURING PROCESS-1**

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

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

**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

**WELDING**

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:**

1. Heine, R.W. C.R. Loper and P.C. Rosenthal, Principles of Metal Casting, McGraw Hill, Hew York-1967.
2. Welding Technology by R.S. Parmar, khanna Publishers.

**PE-217 MANUFACTURING PROCESSES-1 LAB**

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

**L T P**  
**0 0 2**

**CASTING PRACTICALS**

1. To study ingredients of molding sand and core sand.
2. To determine clay content in a moulding sand sample.
3. To determine moisture content in a moulding sample.
4. To find shatter index of moulding sand sample.
5. To conduct hardness test for mould and core.
6. To test tensile, compressive, transverse strength of a moulding sand in dry conditions.
7. Determination of permeability of a moulding sand sample.
8. Measurement of grain fineness number.
9. To study various features of Cupola furnace and its charge calculations.
10. Prepare a green sand mould for any suitable Engineering component.

**WELDING PRACTICALS:**

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.

**PE-211 INDUSTRIAL ORGANIZATION & MANAGEMENT**

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

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

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 scalar, functional, line and staff and functional committee, organization chart- question

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.

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.

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 :**

1. Principles of Management: Koontz and Odonell, Tata McGraw Hill
2. Information Systems for Modern Management: Mudrick, Ross and Clagget, PHI
3. Management Control system, Anthony and Govindarajan .
4. Industrial Organization and Engineering Economics : Sharma and Banga, Khanna Publishers

**4<sup>TH</sup> Semester**

**PE-202 DESIGN OF MACHINE ELEMENTS**

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

**L T P**  
**3 1 0**

1. Scope and meaning of machine design. Sources of design data. Design considerations from economics, manufacturing, aesthetics and ergonomics aspects. Design Process, Selection of Materials.
1. Screwed Joints:- Design of Bolted joints, Bolted Joints under eccentric Loading.
3. Welded Joints :- Design of Fillet Welded Joints, Butt Joints, Unsymmetric Welded sections, Eccentrically loaded welded joints.
4. Rivetted Joints :- Design of Lap Joints, Butt Joints, Diamond Rivetting, Eccentrically loaded riveted joints.
5. Design of Cotter and Knuckle Joints
6. Shafts :- Design of shafts under different types of loading conditions.
7. Keys & Couplings :- Design of rectangular and square keys, muff coupling, split muff coupling, flange coupling, bushed-pin flexible coupling.
8. Levers :- Design of straight levers, Bell –Crank levers, foot levers, hand levers.
9. Brakes and Clutches :- Design of friction plate and cone clutches, and simple type brakes.
10. Introduction to Design for Manufacturing and Assembly

**BOOKS:**

1. Mechanical Engineering Design- J.E. Shigley.
2. Machine Design – Dr. Sadhu Singh
3. A text book of machine design – R.S.Khurmi & J.K.Gupta, S Chand
4. Machine Design – D.K.Aggarwal & P.C.Sharma, S.K Kataria and Sons
5. Design and Manufacturing – Krishnamurthi, S.K. Kataria and Sons

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

**PE-210 DESIGN OF MACHINE ELEMENTS LAB**

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

**L T P**  
**0 0 2**

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 on 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 jointsAnd 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 a engine assembly
8. Design a software in some high level language or excel sheets for design of a component

**PE-204 FLUID MECHANICS & FLUID MACHINERY**

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

**L T P**  
**3 1 0**

**1. 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 & cavitation; compressibility & bulk modulus, Newtonian & non Newtonian fluids.

**2. Fluid statics, kinematics & dynamics:**

- Concept of pressure, Pascal's Law, Buoyancy & floatation, stability of floating & submerged bodies.
- Classification of fluid flows; streamline , pathline & streakline; continuity equation in Cartesian coordinates.
- Euler's equation; Bernoulli's Equation & steady flow energy equation, Impulse momentum equation.

**3. Dimensional Analysis:** Fundamental & derived units & dimensions; dimensional homogeneity ; Rayleigh's & Buckingham's Pi method for dimensional Analysis.

**4. Laminar & Turbulent flows & their measurements:**

- Flow in circular cross section pipes; Turbulent & flow losses in pipes; Darcy Equation.
- Manometers; pitot tubes; venturimeter & Orificemeter; rotameter.

**5. 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.

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

**7. 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.
- Suction /delivery pipes in reciprocating pumps; air vessels.

**BOOKS:**

1. Fluid Mechanics & fluid power Engg. By D.S. Kumar, Metropolitan Publishers
2. Fluid Mechanics by R.K.Bansal,

**PE-212 FLUID MECHANICS & FLUID MACHINERY LAB**

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

**L T P**  
**0 0 2**

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.

**PE-206 Manufacturing Processes-II**

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

**L T P**  
**3 1 0**

**PART-A****1. 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.

**2 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; cutting speed, feed, depth of cut & machining time.

**3 Shapers, Planer and Slotting machine:**

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

**4 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).

**PART-B****4. 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; cutting speed, feed, depth of cut and machining time.

**7. Grinding Machines:**

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

**8. Boring Machines:**

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

**9. Broaching Machines:**

Types of Broaching machines, Broaching tools, Materials for Broach, Cutting action, Chip disposal, applications of broaching, advantages and limitations.

**10. Gear Manufacturing:**

Methods used in production of spur, bevel and worm gears (Powder metallurgy, Moulding, Forming, Rolling, Gear hobbing and shaping), Gear finishing.

**Books Suggested:**

1. Manufacturing Processes: Myron L. Begeman
2. Production Technology : H.M.T.
2. Manufacturing processes: Hazra Chowdhary (Vol. 2.)
3. Production Technology : O.P.Khanna
4. Production Technology : R.K.Jain
4. Production Engg. Sciences : Panday & C.K Singh.

**PE-214 Manufacturing Processes -II LAB**

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

**L T P**  
**0 0 2**

1. Study of 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

**PE-208 STATISTICS AND NUMERICAL ANALYSIS**

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

**L T P**  
**3 1 0**

**PART A**

**SAMPLING THEORY**

Introduction: Normal sampling distributions; Sampling distribution of the means; sampling distribution of the differences of the means; sampling distributions of proportions.

**TESTS OF SIGNIFICANCE**

t-distributions, chi square distributions, F-distributions.

**REGRESSION AND CORRELATION**

Linear regression; correlation, multiple correlation & partial correlation

**CONFIDENCE LIMITS**

Large samples, small samples, error bands in regression

**PART B**

**NUMERICAL METHODS**

Errors and significant digits, Roots of algebraic equations Bisection method, secant method, Newton Raphson method, Graff's root- squaring method, Iterated synthetic division with quadratic factors method for finding complex roots, solutions of systems of

equations (Gauss elimination, Gauss Jordan, and Partition method for linear system of

equations, power method for partition, method for linear system of equations, power method for finding eigen values), Forward, backward, central and Divided differences,

Newton's formula of interpolation for equal and unequal intervals. Lagrange's interpolation formula, Stirling's and Bessel's formula, Numerical differentiation, Numerical Integration :-Trapezoidal, Simpson's rule and Gaussian integration (only formula applications) Differential equations and their solutions. Numerical methods for

ordinary differential equations(Picard method, Taylor series method, Euler's method, Ranga Kutta Method, Predictor- corrector method, Adams- Bashforth method. ) .

**BOOKS:**

1. Introductory methods of numerical analysis by S.S.Sastry : Prentice Hall of India
2. Statistical methods for Engineers, John P. Kennedy Thomas Y, Crowell Co.
4. Elementary Numerical Methods, B.S. Grewal, Khanna Publication New Delhi.
5. Introduction to Statistics, Rovert V. hong, Macmillan Pub. Co.
6. Elementary Numerical Analysis, S.D. Conte, & Cari De Boor. Mc Graw Hill.
7. Applied Numerical Methods, Cornahn B., Et al, John Wiley.

**PE-216 LAB STATISTICS AND NUMERICAL ANALYSIS**

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

**L T P**  
**0 0 2**

Computer programming of Numerical methods for:

1. Solving algebraic and transcendental equations (Bisection, Newton Raphson and Graffe's root squating)
2. Solving system of equations (gauss elimination and Gauss Jordan)
3. Solving interpolation and extrapolation of data (Newton's methods)
4. Solving integration
5. Solving Ordinary differential equation.

**ME-205 ENGINEERING MATERIALS & METALLURGY**

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

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

1. 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) nucleation (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, recrystallization, preferred orientation causes and effects on the property of metals.
2. Introduction to Engineering materials; their mechanical behavior, testing and manufacturing properties of materials; physical properties of materials; classification of engineering materials.
3. 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
4. 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:**

1. Engg. Physical Metallurgy , Y. Lakhtin, Mir Publishers
2. Heat Treatment of Metals, B. Zakhav
3. Engineering Metallurgy, V. Raghavan

**ME-213 ENGINEERING MATERIALS & METALLURGY LAB**

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

**L T P**  
**0 0 2**

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.

**5<sup>th</sup> Semester****PE-301 OPERATIONS RESEARCH**

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

**L T P**  
**3 1 0**

**Introduction:** Nature and developments of operations research, characteristics of operations research, necessity of operations research in industry, scope of OR in management, objectives of OR, models in OR, role of computers in OR, limitations of OR.

**Linear Programming:** Requirements of linear programming problems, formulation of linear programming problem, 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.

**Transportation model:** Definition of transportation model, formulation and solution methods, and degeneracy in transportation problems.

**Assignment Model:** Definition of assignment model, comparison with transportation model, formulation and solution methods, the travelling salesman problem.

**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.

**Simulation:** When to use simulation, Advantages and limitations of the simulation technique, generation of random numbers, Monte-Carlo simulation, computer-aided simulation: applications in maintenance and inventory management.

**PERT and CPM:** Work breakdown structure, network logic, critical path, CPM Vs PERT, slack and floats.

**Suggested Books**

1. Operations Research by P.K. Gupta and D.S.Hira. S. Chand and company
2. Operation Research -,An Introduction A.H. Taha Macmillan Publishing Co
3. Executive Decisions and operations Research by W.D. Miller and M.K Starr ,Prentice Hall Inc, Eglewood Cliffs, N.J,

**PE 303 MACHINING SCIENCE**

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

**L T P**  
**3 1 0**

**INTRODUCTION TO MACHINING PROCESSES:** Classification of machining processes; Introduction to Single point, multipoint and abrasive machining operations. Calculations of machining parameters in Turning and Boring, Drilling, Grinding, Milling, Shaping Operations.

**TOOL GEOMETRY:** Single point cutting tools, single point cutting tool specifications, Selection of tool angles, multipoint cutting tools, geometry of lathe, milling, drilling and broaching tools.

**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.

**TOOL WEAR AND TOOL LIFE :** Introduction, tool wear, wear mechanism, tool life, variables affecting tool life, determination of tool life exponents, machinability,

**THERMAL ASPECTS OF MACHINING :** Introduction, equations of heat flow, temperature in orthogonal cutting, experimental determination of cutting temperatures, cutting, fluids, their selection and application.

**MEASUREMENT OF CUTTING FORCES:** Introduction, need, and basic methods of measuring cutting forces, Dynamometer requirements, Working Principles and construction of lathe Dynamometer, Drilling Dynamometer and Milling Dynamometer

**ECONOMICS OF MACHINING:** Machining cost, optimum cutting speed, restrictions on cutting conditions, and comparison of the criteria.

**BOOKS:**

1. Introduction to Machining Science, G.K. Lal, New Age International Ltd,
2. Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja .,G.S. Sekhon, New Age International Ltd
3. Metal cutting Principles by A. Bhattacharya, CBS Publishers

**PE 305 ENGG METROLOGY**

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

**L T P**  
**3 1 0**

**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; Magnification 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.

**6. 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.

**7. 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. Engineering Metrology            | R.K.Jain, S Chand and Company      |
| 2. Engineering metrology            | I.C.Gupta                          |
| 3. Mechanical Measurement & Control | D.S.Kumar, Metropolitan Publishers |
| 4. Mechanical Measurement           | Doebelin, Mc graw Hill             |

**PE- 307 Metal Forming**

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

**L T P**  
**3 1 0**

**Section-A**

Classification of metal forming processes, hot and cold working processes & 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.

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

**Section-B**

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 backpull 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.

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 & cold rolling, rolling defects, causes and remedies.

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.

**Books**

1. Principles Industrial metal working processes - Row, Pretice Hall of India
2. Metal working by Surinder Kumar, Dhanpat Rai and Sons
3. Metal Forming by Avitzur, Marcel Dekker

**PE 309 INSPECTION & QUALITY CONTROL**

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

**L T P**  
**3 1 0**

**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

**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.

**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.

**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.

**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 ( $\bar{X} - R$ ,  $X - \bar{X}$  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 Roming and Military Standards Sampling Tables.

**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

**Recommended Books**

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

**PE 311 Jigs, fixtures and Press Tool Design**

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

**L T P**  
**2 0 0**

**1. Process Planning:**

Definition; Importance of Process Planning; Selection and Sequence of operations, Machines, Tools/Die sets, Gauges etc.; Process Planning Sheet; Actual problems.

**2. Jigs & Fixtures:**

Definition; Classification of Jigs & Fixtures; When a Jig or a Fixture is needed, Principles of economics of Jigs & Fixtures; Principle 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**

1. Jigs & Fixtures : Franklin D. Jones
2. Die Design : A.S.T.M.E.
3. Tool Design : Cyril Donaldson, Locain & Goold
4. Jogs & Fixtures Design Manual : E. Henrikson, Indl. Press.
5. Jigs & Fixtures Design : Colvin & Hass.

**PE- 313 MACHINING SCIENCE LAB**

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

**L T P**  
**0 0 2**

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 dynamometer 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 315 ENGG METROLOGY LAB**

**Internal Marks: 30**

**External Marks: 20**

**Total Marks: 50**

**L T P**

**0 0 2**

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  
1) Tool Makers Microscope &  
II) Profile Projector.
6. To check the flatness of surface plate by Auto-collimator.
7. To check the diameter of a rod by comparators and slip gauges.
8. Find out the strain in a given workpiece under given loading by using strain gauges.
9. Calibration of pressure gauges.

**PE 317 METAL FORMING LAB**

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

**L T P**  
**0 0 2**

1. 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 semicone 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.

**PE 319 JIGS, FIXTURES AND PRESS TOOL DESIGN LAB**

**Internal Marks: 30**

**L T P**

**External Marks: 20**

**0 0 4**

**Total Marks: 50**

1. Students will be given at least one practical problem regarding design and fabrication of Jig, Fixture or Press tool.
2. Working drawings of the following:-  
Drilling Jigs (Box type, Leaf type, Indexing type, Trunion type etc.)
3. Milling Fixtures
4. Grinding fixtures
5. Assembly and welding fixtures (for automobile components and frames etc.)
6. Drawing Dies, Bending Dies, Compound Dies, Combination Dies & Progressive Dies.

## PE 302 INDUSTRIAL ENGINEERING

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

**L T P**  
**3 1 0**

**INTRODUCTION:** Definition and scope of industrial engg, role of an industrial engineer in industry, functions of industrial engg. Department and its organization, qualities of an industrial engineer

**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.

**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

**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.

**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.

**VALUE ENGINEERING:** Types of values, concept of value engg., phases of value engg. Studies, application of value engg.

**WORK DESIGN:** Concepts of job enlargements, job enrichment and job rotation, effective job design considering technological and behavioural factors.

**ERGONOMICS:** Introduction to ergonomics consideration in designing Man Machine systems with special reference to design of displays and controls.

### **BOOKS:**

1. Introduction to Work Study by Gayler Shotbolt.
2. Industrial Engg. And management by Hicks, Tata McGraw Hill.
3. Product Design and Development by Ulrich, Tata McGraw Hill
4. Work Study and ergonomics by Suresh Dalela and Saurabh, Standard Publishers.
5. Motion and time study by R. Bernes, John Wiley and sons.
6. Ergonomics at work by D. J. Osborne, John Wiley and sons.
7. Techniques of value analysis and engg. By Miles Tata McGraw Hill

**PE 304 MODELING AND SIMULATION**

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

**L T P**  
**3 1 0**

**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

**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

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

**List of Recommended Books**

1. System Simulation with Digital Computer: Deo Narsingh PHI
2. System Simulation: Gordon, PHI
3. Analog Computation : Jackson A.S. Mcgraw hill
4. Computer Simulation Techniques : Naylor T.H. et. al. John wiley
5. Modern Production Management: Buffa Wiley

**PE 306 PRODUCT DESIGN & DEVELOPMENT**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

**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.

**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.

**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,

**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.

**PRODUCTS DEVELOPMENT:**

Definition and objective, Role of designer in product development. Manufacturing and economic aspects of product development, Product promotions, product developments,

**BOOKS:**

1. Mayall W.H., "Industrial Design for Engineers" London Liifee Books Ltd. 1967
2. Dale Huchingson R "New Horizons for Human Factors in Design " McGraw Hill Company 1981.Industrial Design-Mayall
3. Engineering Design- Svensson.
- 4., Engineering Design-Matousek
5. McCormick K.J. (Ed) "Human Factor Engineering " 4<sup>th</sup> edition McGraw Hill Book Company Ltd. USA 1992

### PE 308 Tool and Cutter Design

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

**L T P**  
**3 1 0**

#### Introduction:

Cutting Tool materials, Theories of tool failure, 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 Purpose and principles types Design Elements and Geometrical parameters of the Tool point. Design for dimensions, of H.S.S Tools. Constriction and design of carbide and ceramic tipped tools Chip breaker purpose constriction and design. Design of High production ,Tools Principles types and their design.
3. Design of Drills Purpose and principal types Twist Drill geometry, construction and design, Carbide tipped drills, modification of drill point chisel edge,
4. Design of Form Tool. Purpose and types: Radial feed and tangential type form tool construction and design, Determination of correct profile of form tools,
5. Design of milling cutters, Purpose types and geometry of milling cutters, Design of profile sharpened plain milling enter, Face milling cutter side milling eutters, Design of circular saw and profile sharpened End Mill. Design of Form Relived Milling Cutters,
6. Design of Broaches, Purpose and Principles types. Design and construction of internal Broaches and External Surface broaches.
7. Elementary discussion on the types and construction of Reamers, Core drills, thread cutting tools gear cutter tools, abrasive tools.
8. Sharpening of single point tools and twist drills heat treatment procedure of cutting tools,

#### BOOKS

1. Tool Design by Donaldson
2. Metal Cutting Principles and cutting Tool Design and Production by Arshinov & Others
3. Tool and Cutting Design and Production, M.Palay
4. Tool and Cutting Design Design A,Bhattacharya

## **CE-216 ENVIRONMENTAL SCIENCE**

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

**L T P**  
**3 1 0**

### **Unit 1 : The Multidisciplinary nature of environmental studies**

Definition, scope and importance

(2 Lectures)

Need for public awareness.

### **Unit 2 : Natural Resources :**

#### **Renewable and non-renewable resources :**

Natural resources and associated problems.

- a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources : Use and over-Utilization of surface and ground water, floods, drought, conflicts and water, dams-benefits and problems.
- c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
- f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

### **Unit 3 : Ecosystems**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

### **Unit 4 : Biodiversity and its conservation**

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ conservation of biodiversity.

## **Unit 5 : Environmental Pollution**

### **Definition**

- Causes, effects and control measures of :-
  - a. Air pollution
  - b. Water pollution
  - c. Soil pollution
  - d. Marine pollution
  - e. Noise pollution
  - f. Thermal pollution
  - g. Nuclear hazards
  
- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

## **Unit 6 : Social Issues and the Environment**

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people ; its problems and concerns. Case studies.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
  
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.

- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

(7 lectures)

### **Unit 7 : Human Population and the Environment**

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV / AIDS
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

### **Unit 8 : Field work**

- Visit to a local area to document environmental and river forest grassland hill mountain.
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

**PE 310 INDUSTRIAL ENGINEERING Lab**

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

**L T P**  
**0 0 2**

1. Determination of time standard 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 carryout a work sampling study.
5. To conduct process capability study for a machine in the workshop.
6. To design a sampling scheme based on OC curve.
7. To conduct Shewart's experiments on known population
8. Generation of random numbers for system simulation such as facility planning, job shop scheduling etc.

**PE 312 MODELING AND SIMULATION LAB**

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

**L T P**  
**0 0 2**

1. Generate Pseudo Random No. using different Techniques.
2. Develop an Analytical Model for a given physical system.
3. Develop a Monte-Carlo Simulation Model for a given physical system.
4. Find a area of an irregular 2-D shape using Monte-Carlo Simulation
5. Find the effectiveness of simulation on a physical Stochastic System
7. Develop an algorithm for a selected Simulated Study and write the program in a high level language.

**PE 314 PRODUCT DESIGN AND DEVELOPMENT LAB**

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

**L T P**  
**0 0 2**

**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

## **INDUSTRIAL TRAINING**

### **(PROBLEM SOLVING/PROJECT ORIENTED WORK BENCH INVOLVEMENT)**

**Marks- 1000**

#### **Duration**

Full Sixth or Seventh Semester is meant for Industrial Training

#### **Purpose "**

To expose engineering students to technology development at work places and appraise them regarding shop-floor problems "

To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking

#### **Programme**

During this work bench involvement, students will be given 3-4 practical problems. The problems assigned should be of mutual interest to the students and the industry. The problem may belong to 3 or 4 different functional areas. To illustrate, following are some of the suggestions: "

Design of a prototype

- " Programming of CNC machines
- " Calibration and testing of instruments
- " Productivity Improvement Studies
- " Pollution control related problems
- " Capacity Planning and Capital Budgeting
- " Safety Management
- " Conflict Management

#### **Methodology**

- “ The industrial organizations where students are to be sent for problem solving project-oriented work bench involvement may be selected well in advance
- “ The faculty of the department is expected to visit the selected industries and identify suitable problems to be handled by students.
- “ It will be desirable that problems be matched with the interests of students.
- “ It is recommended that a group of 5-6 students be guided by one faculty member during this period.

The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- “ Punctuality and Attendance “ Interpersonal relations
- “ Sense of Responsibility
  - Clarity of concepts, principles and procedures
- “ Self expression/communication skills
- “ Report Writing Skills
- “ Creativity/conceiving new and unusual ideas
- “ Problem-solving skills

**PE-402 COMPUTER INTEGRATED MANUFACTURING**

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

**L T P**  
**3 1 0**

**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, mini computer, micro computer, P.C., Super Computers.

**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**

**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.

**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.

**COMPUTER AIDED PROCESS PLANNING:** Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data system, computer generated time standards.

**GROUP TECHNOLOGY:** Introduction, part families, part classification and coding, coding system and machining cells.

**COMPUER 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.

**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.

**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.

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS:** Introduction, types special manufacturing systems, flexible manufacturing systems (FMS), Machine tools and equipment, material handling systems, computer control systems.

**BOOKS:**

1. CAD/ CAM- Groover & Zimmer, Prentice Hall
2. Automation Production Systems and CIMS – Groover, Prentice Hall.
3. CAD/ CAM – Beasanat & Lui, EWP.
4. Material Handling Hand Book, McGraw Hill.
5. Industrial Robotics – Groover Mitchell, McGraw Hill.

**PE-404 Non Traditional Machining**

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

**L T P**  
**3 1 0**

**Detailed Syllabus:**

**Modern Machining Processes:** An Overview, trends in Manufacturing machining, transfer machining, flexible machining system, computer integrated manufacturing

**Advanced Mechanical Processes:**

Ultrasonic machining and Abrasive Flow Machining, Abrasive Water Jet Machining- elements of process, Applications and limitations

**Electrochemical & Chemical Removal Processes:**

Principle of operation, elements and applications of Electrochemical Machining, Electrochemical grinding, Electrochemical deburring, Electrochemical honing, Chemical Machining:

**Thermal Metal Removal Processes:**

Electric Discharge Machining- Mechanism of metal removal, , electrode feed control, die electric 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

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

**Books:**

- 1) Modern Machining Processes by P.C. Panday and H.S. Shan, Tata Mc Graw Hill
- 2) Fundamentals of Machining and Machine Tools by G. Boothroyd and W.A. Knight, Mareel Dekker Inc.
- 3) Non traditional Manufacturing Processes, G.F. Benedict, Marcel Dekker Inc.

**PE-406 MACHINE TOOL DESIGN**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

**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.

**KINEMATICS OF MACHINE TOOLS,**

Kinematics or gearing diagram of Lathe, drilling Machine, Milling Machine etc. Main drive and feed drive, principles specification of Machine tool.

**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.

**SPEED AND FEED BOXES;**

General requirement Design of gear trains, speed boxes types, speed changing devices Feed boxes characteristics of feed mechanism, types of Rapid traverse mechanisms, variable devices.

**SPINDLE DESIGN AND SPINDLE BEARINGS.**

Main requirement, Materials and details of spindle design, Spindle bearings, bearings, types of bearings and their selections, Bearing Materials BED,

**COLUMNS, TABLES AND WAYS;**

Materials, typical constructions and design.

**MACHINE TOOLS CONTROL SYSTEMS**

Requirement of control system selection and construction of control systems Mechanical control system, predilection control, remote control safety devices.

**MACHINE TOOL DYNAMICS**

Dynamic performance, dynamic and elastic system of Machine, tools. Dynamics of cutting forces, tool chatter.

**BOOKS:**

- 1, Sen and Bhattacharya, Machine Tools Design., CBS Publishers
2. N.K. Mehta Machine Tool Design, Tata Mc Graw Hill.
- 3, N. Acherkan Machine Tool Design, Four Volumes,.Mir Publishers.,
5. S.K. Basu and D.K. Pal, Design of machine tools, Oxford and IBH

## PE-408 INDUSTRIAL AUTOMATION AND ROBOTICS

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

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

### 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); 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 pendent.
- 8. Industrial Applications** of Robots for material transfer, machine loading / unloading, welding, assembly and spray painting operations.

### Books

1. Fluid Power with applications by Anthony Esposito
2. Pneumatic Control by SR Majumdar
3. Robotics and Flexible Automation by SR Deb

**PE 410 COMPUTER INTEGRATED MANUFACTURING Lab**

**Internal Marks: 30**

**L T P**

**External Marks: 20**

**0 0 2**

**Total Marks: 50**

1. Computer aided design of the following machine components.

1) Shafts

ii) Gears

iii) Coupling

iv) Cam

v) Springs

vi) Bearings

2. Auto CAD Practice for 2-d & 3-D machine components

3. Write the part program for the components having the following operations with different combinations and manufacturing the component on CNC lathe using brass/Al wood or wax, operations

i) Straight and Taper turning

ii) Chamfering

iii) Circular Arc turning

iv) Threading , Drilling etc.

**PE-414 INDUSTRIAL AUTOMATION AND ROBOTICS LAB**

**Internal Marks: 30**

**External Marks: 20**

**Total Marks: 50**

**L T P**

**0 0 2**

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

**Group-I**

**DE/PE-1.1 ARTIFICIAL INTELLIGENCE IN MANUFACTURING**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

**Introduction**

Concept and Understanding A-I, Representation of facts, Predicates and predicate expressions and types Semantics with and without multiple arguments., Variables and queries, Single and multidirectional queries matching alternatives, multi condition queries, negative predicate expressions, back tracking. The generate and test scheme.

**Definitions and Inferences**

Rules and fact orders, rules as programs, rules in natural language, rules; without right side, back tracking with rules, transitive and inheritance/inferences.

**Arithmetic and lists in prolog**

Comparisons, assignments reversing, lists creating and processing predicates combining list predicates.

**Control structure for rules based systems**

Backward and forward chaining, Hybrid control structures, meta rules decision lattices, concurrency in control structures, AND -OR-NOT Lattices, randomness in control structures, grammars for interpreting languages. Rule based system-implementation:- Backward chaining, virtual facts and catching, implementation. Input/output coding, intermediate predicates, probability in rules, independence-assumption and or combination. Search:- State operators, search as graphical traversal search strategies; depth first and breadth first heuristics. cost and evaluation function optimal path search. Backward VS. forward chaining using probability in search.

**Abstraction of facts**

Partitioning facts, frames and slots, frames with components, frames as forms, slot inheritance, past-kind inheritances, extension Vs. intentions, procedural attachment, frames in prolog, frames for natural language under standing.

**BOOKS:**

1. Artificial Intelligence through prolog., C.Neil Rowe, Prentice Hall.
2. Introduction to Expert Systems, Ignizio, McGraw hill.
3. Handbook of Artificial intelligence, Feigenbarrm E.A..
4. Artificial intelligence, P.H.Winston.

## DE/PE1.2 INDUSTRIAL FINISHING TECHNOLOGY

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

**L T P**  
**3 1 0**

### FINAL FINISH SURFACE OPERATIONS

Introduction to finishing operations, significance and applications in Industry, classification of Industrial finishing processes

Mechanical Finishing processes: Deburring, 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

### 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 depositon. Painting ;and organic coating, polymerization methods. undercoating, brush dip, flow, Electrolytic spraying. Rust prevention, principles, types selection of coatings, safety.

### BOOKS;

1. B.F. Blumdel, 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.

**DE/PE-1.3 WELDING TECHNOLOGY**

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

**L T P**  
**3 1 0**

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**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

**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.

**Fusion Welding**

Comparison of TIG, MIG and Co<sub>2</sub> welding processes, Plasma arc, submerged arc welding, electro gas and Electroslag welding,

**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,

**Advanced Welding processes:**

Technology, Scope and Application of Electron beam Welding , Laser welding, Under Water Welding processes.

**BOOKS:**

1. The physics of welding by Lancaster; pergaman Press.
2. The metallurgy of welding by lancster; Georga Allen & Unwin Ltd. U.K.
3. Welding Handlook, Vol.1 & 2, Seventh edition; American Welding Society.
4. Metal Handbook Vol.16, 73. ASME.
5. The solid phase welding of metals by Tylecote; Edward Arnoli P Ltd.
6. Welding and Welding Technology by Richard L.Little, Mc.Graw Hill.
7. Welding for Engineers by Udin; Frame & wuff ; Johnmiles.

**DE/PE1.4 Plastic and Ceramic Technology**

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

**L T P**  
**3 1 0**

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 such as 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, under, cuts, 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:**

1. Mechanics of plastics processing properties, A.W. Birley, B. Howarth, Hana Publisher edition, 1991
2. Inorganic Polymers, J.E. Mark, R. West, H.P. Allocock, Prentice Hall, 1992
3. Poly. Science and Technology, Fried, Prentice Hall
4. Plastic Engg. Hand Book, Frados
5. Plastic Technology, Pattan
6. Plastic Engg. Data Book, Glanill

**DE/ME-1.5 NON-DESTRUCTIVE TESTING**

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

**L T P**  
**3 1 0**

Introduction

Classification of techniques of material testing, Need and Significance of Non Destructive Testing methods, type of Non Destructive testing methods,

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

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

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

Photoelasticity

Concept and applications of Plane and circular polarization, Photostress, models,

**Books**

The testing of Engg materials H.E. Davies, G.E Troxell, GFW Hauck. Mc Graw Hill Publishers

Mechanical Inspection by W.H Armstrong Mc Graw Hill Publishers

**DE/ME –1.6 MAINTENANCE AND RELIABILITY ENGINEERING****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

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 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

7. 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**

1. Maintenance Engineering Handbook by Higgins LR
2. Principles of Planned Maintenance by Clifton, RH
3. Industrial Maintenance by Garg HP; S. Chand and Co
4. Maintenance planning control by A Kelly (Indian ED)
5. Reliability Engineering by LS Srinath
6. Reliability Engg. S.K Sinha. Wiley Eastern.
7. Reliability Engg., Lewis, John Wiley.

**Group-II**

**DE/PE-1.7 INVESTMENT PLANNING**

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

**L T P**  
**3 1 0**

**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;**

1. Financial Management. J.M.Pandey.
2. Financial Management & Policy. James Van Home.
3. Project Management. Harold Kerzner.
3. Financial Management. Prasanna Chandra.

**DE/PE-1.8 Technology Management**

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

**L T P**  
**3 1 0**

Issues and Application, concepts to technology; role and importance of technology management, Dimensions of technology management, technology management in India.

Technological Change:

Nature of technological change, motivation for technological change . Invention and Innovation, Technology Life Cycle, technology monitoring.

Technology Forecasting:

Objectives and approaches, methodology of technological forecasting Delphin technique, growth curves, morphological analysis, technological discontinuities Indian technology Vision 2020.

Technology Planning:

Technology and Socio economic Planning, choice of technology, Process of technology generation, Integrating business and technology strategies, technology development approaches, Technology audit.

Organisation for technology management; technological change and manufacturing complexity risks in new technology projects, implementing technology.

Management of R & D:

Corporate strategy, Selection of R & D projects, Managing R & D projects, Marketing of R & D.

Management of Innovation: Radical and cyclic innovative processes, technology strategy and innovation. Technology Absorption and Diffusion:

Technology dependence, concepts in technology absorption in technology absorption, management of technology absorption, technology absorption and adaptation scheme (TAAS), concepts of diffusion of technology, Prospective on diffusion, developing diffusion strategies.

Technology Transfer: Models of technology transfer, technology transfer modes, Dimensions of technology transfer, Premising of technology government policies on technology transfer. Role of Intellectual Property Rights: Nature of IPR, Patent, Trademark and copy rights. Legal aspects.

Managing Process Technology: Continuous improvement technology integration, product and process technology techniques of improvement, economics of improvement.

Technology as Competitive Strategy: Competitive analysis, core competitive competencies, technology leadership, adoption of new technology, marketing of new technology. Case studies on technology management.

**Books**

1. Strategic Technology management Betz, McGraw Hill
2. Technological Innovation in Education, Yao Tzuli, Van Nostrand
3. Effective Management R & D, Gerstenfeld, Addison Wesley
4. Third Generation R & D, Ronssel, Drickson & Little
5. Management of technology, Paul Loms
6. Science Technology and Industrial Development in India, S.C. Pakrashi & G.P. Phondke
7. Journal of Science & Industrial Research, C.S.I.R
8. Tech. Monitor, Asia Pacific Centre for transfer of tech. , New Delhi

**DE/PE-1.9 MARKETING & FINANCIAL MANAGEMENT**

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

**L T P**  
**3 1 0**

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,

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

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**

1. Marketing, Management Philip Kotler.
2. Financial Management. I.M.Panday.
3. Marketing Management. Ramaswamy & Namakumari.
4. Marketing Management. J.C.Gandhi.
5. Financial Management . Prasanna Chandra.

**DE/PE-2.4 PROJECT MANAGEMENT**

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

**L T P**  
**3 1 0**

**INTRODUCTION:** Concept of a project, types of project, project life cycle phase, project development, project identification and selection, feasibility study.

**PROJECT MANAGEMENT:** functions, comparison with traditional management, forms for project management in industry and service sector

**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.

**PROJECT SCHEDULING:** Gantt Charts, Network Scheduling, PERT and CPM, Worked examples of PERT and CPM.

**PROJECT MONITORING:** Line of Balanced and Pace (Performance and Cost Evaluation) techniques.

**PROJECT CONTROL:** Project control process, performance analysis, internal and external project control, approaches to project control, control problems.

**HUMAN ASPECTS OF PROJECT MANAGEMENT:** Leadership in project management, the role of project manager, project team, motivation and group cohesiveness.

**BOOKS:**

2. Project Management, S. Choudhary, Tata Mc Graw Hill.
3. Managing Business and Engineering Projects, Nicholas, Prentice Hall.
4. Project Preperation, Appraisal, Budgeting and Implementatipon, Prasanna Chandra, Tata McGraw Hill.

## DE/PE-2.0 PRODUCTIVITY MANAGEMENT

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

**L T P**  
**3 1 0**

**Introduction:** Definition of Productivity, Productivity and performance, production, benefit cycle, Industrial productivity, scope of productivity management, factors affecting productivity, different approaches to productivity.

**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.

**Productivity Planning:** Causes for productivity changes, productivity models, applications of different planning models, productivity planning executives and their responsibilities.

**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.

**Productivity Improvement:** Causes of poor productivity, remedies of poor productivity, methods to improve productivity, design of productivity improvement programmes.

**Dynamic Programming Of Productivity Problems:** Static and dynamic causes of lower productivity, optimization of productivity.

### Books

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

**DE/ME -2.1 OPERATIONS MANAGEMENT**

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

**L T P**  
**3 1 0**

**NEED AND SCOPE OF OPERATION MANAGEMENT:** Types of production system and their characteristics, productivity definition, types and measurements

**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.

**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

**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

**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,

**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

**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

**MANAGEMENT INFORMATION SYSTEMS:** Introduction to MIS, Steps in designing MIS, Role of Computers in MIS

**MAINTENANCE SYSTEMS:** Type of maintenance, objective of maintenance, Planned maintenance strategies, preventive maintenance, condition monitoring and total productive maintenance

**BOOKS:**

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

**DE/ME –2.2 TOTAL QUALITY MANAGEMENT**

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

**L T P**  
**3 1 0**

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:**

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

**DE/ME –2.3 MATERIAL MANAGEMENT**

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

**L T P**  
**3 1 0**

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**

1. Materials Management by M.M Verma, S. Chand and Sons
2. Material Management - An Integrated Approach by gopal Krishnan and sundaresan : Prentice Hall
3. Purchasing and materials management by Dobbler and Burt; Tata McGraw Hill
4. Inventory control by Starr and Miller

DE/ME-2.5 **HUMAN RESOURCE MANAGEMENT**

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

**L T P**  
**3 1 0**

**Introduction:** Introduction to Human Resource Management and its definition, functions of Human Resource Management & its relation to other managerial functions. Nature, Scope and Importance of Human Resource Management in Industry, Role & position of Personnel function in the organization.

**Procurement and Placement:** Need for Human Resource Planning; Process of Human Resource Planning; Methods of Recruitment; Psychological tests and interviewing; Meaning and Importance of Placement and Induction, Employment Exchanges (Compulsory Notification of vacancies) Act 1959, The Contract Labour (Regulation & Abolition) Act 1970.

**Training & Development:** Difference between training and Development; Principles of Training; Employee Development; Promotion-Merit v/s seniority Performance Appraisal, Career Development & Planning.

**Job analysis & Design:** Job Analysis: Job Description & Job Description, Job Specification.

**Job Satisfaction:** Job satisfaction and its importance; Motivation, Factors affecting motivation, introduction to Motivation Theory; Workers ' Participation, Quality of work life.

**The Compensation Function:** Basic concepts in wage administration, company's wage policy, Job Evaluation, Issues in wage administration, Bonus & Incentives, Payment of Wages Act-1936, Minimum Wages Act-1961

**Integration:** Human Relations and Industrial Relations; Difference between Human Relations and Industrial Relations, Factors required for good Human Relation Policy in Industry; Employee Employer relationship Causes and Effects of Industrial disputes; Employees Grievances & their Redressal, Administration of Discipline, Communication in organization, Absenteeism, Labour Turnover, Changing face of the Indian work force and their environment, Importance of collective Bargaining; Role of trader unions in maintaining cordial Industrial Relations.

**Maintenance:** Fringe & retirement terminal benefits, administration of welfare amenities, Meaning and Importance of Employee Safety, Accidents-Causes & their Prevention, Safety Provisions under the Factories Act 1948; Welfare of Employees and its Importance, Social security, Family Pension Scheme, ESI act 1948, Workmen's Gratuity Act 1972, Future challenges for Human Resource Management.

**Recommended Text Books:**

1. T.N.Chhabra- Human Resource Management (Dhanpat Rai & Co.)

**Recommended Reference Books:**

1. Lowin B. Flippo - Principles of personnel Management (Mc Graw-Hill)
2. R.C. Saxena - Labour Problems and social welfare (K.Math & Co.)
3. A Minappa and M. S. Saiyada - Personnel Management (Tata Mc. Graw-Hill)
4. C.B. Mamoria - Personnel Management (Himalaya Publishing House, Bombay)
5. T.N. Bhagotiwai - Economics of Labour and Industrial Relations (Sahitya Bhawan Agra)

**Group-III**

**DE/PE-2.6 INDUSTRIAL PACKAGING**

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

**L T P**  
**3 1 0**

**Introduction:** Objectives and functions of industrial packaging, different types of industrial packaging, economics of industrial packaging.

**Materials For Industrial Packaging:** Characteristics of a good packaging material, comparison of materials for industrial packaging, factors affecting the selection of packaging materials, packaging materials for special requirements.

**Industrial Packaging Design:** Requirements of a good package design, design considerations for compatibility, separation, enclosure, retention, handling and transportation, package graphic design, package as a means of information & identification, ecological considerations in packaging design selection and use.

**Multiple Function Industrial Packaging:** Concept and objectives of multi purpose-packaging, design considerations, cost analysis of multiple functions industrial packaging, Containers, their types, materials, design factors.

**R&D For Industrial Packaging:** Cost reduction techniques, composite material design and development, bio-degradable packaging materials.

**Books**

1. Sharma, Package Management, Khanna Publishers, New Delhi
2. Daniel A Wren, Management Innovations, Oxford University Press, New York
3. Michael L, Tushman, Managing Package Changes, Oxford University Press, New York
4. Packaging Hand Book, Indian Institute of Packaging (India)

## DE/PE-2.7 NETWORK ANALYSIS

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

**L T P**  
**3 1 0**

### Introduction

Characteristics of effective planning, historical background to network charts, where network charts can be used; the basic essentials; analysis and scheduling; controlling and introducing PERT & CPM into an organisation.

### Elements of a Network

Activities and events; conventions adopted in drawing networks; the graphical representation of events and activities; identification of activities; fundamental properties of events and activities; errors in logic;

### Drawing the Network

Drawing the network; interfacing; duration times; duration times under uncertainty; PERT, assigning duration times, numbering the events, listing the events and activities; drawing arrow diagrams.

### Analyzing the Networks

Calculating the total project time; isolation of the critical path- earliest and latest events, time; total float; free and independent float; negative float; use of different float.

### Applications

Application of PERT and CPM; calculation of the load; the problem of optimisation, smoothing the load; scheduling manual resource allocation.

### NOP Networks

Representation of logic in MOP; representation of time-milestone in MOP; analysis of a MOP network resource allocation; matrix method of expressing and analysis MOP diagrams.

### Introduction to LOB Networks

Where LOB be used; node times LOB chart; LOB life table control using LOB.

### Books:

1. CPM in Construction Management O'Brien McGraw-Hill
2. Network Based Management System Archibald & Villaria John Wiley
3. A Programmed Introduction to PERT Federal Elect.Corp. Prentice Hall
4. A Management Guide to PERT/CPM Wiest & Levy Prentice Hall
5. Management by Network Bhattacharya Institution of Engrs

**DE/PE-2.8 ENVIRONMENTAL DEGRADATION OF**  
**MATERIALS**

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

**L T P**  
**3 1 0**

Introduction to material science and engineering, classifications of engineering materials and introduction to environmental degradation of materials.

**Aqueous Corrosion:** Nature, Kinetics, passivity and corrosion rate measurements. Classifications of Aqueous corrosion, General corrosion, Galvanic corrosion, Pitting, Crevice corrosion, Erosion-corrosion and corrosion cracking.

**Aqueous corrosion prevention:** Materials selection, control of environment, Protective coatings, Cathodic protection, Anodic protection and Design improvement.

**Oxidation:** Introduction, doping effect, internal and catastrophic oxidation, hot corrosion, protective coatings for high temperature applications, corrosion by liquid metal.

**Hydrogen and Radiation Damage:** Types, theories and preventive methods of hydrogen damage. Radiation induced defect production, Irradiation growth and void swelling, Radiation-enhanced Creep, Irradiation Strengthening and Embrittlement.

**Books**

1. Environmental Degradation of Metals By U. K. Chatterjee, S. K. Bose and S. K Roy (Marcel Dekker, 270 Madison Avenue, New Yor).
2. Engineering Materials, Properties and Selection by K. G. Budinski (Prentice-Hall of India, New Delhi).
3. An Introduction to Metallic Corrosion and its Prevention by R. Narayan (Oxford & IBH Publishing Co., 66 Janpath, New Delhi).
4. High Temperature Oxidation of Metals by P. Kofstad (John Wiley and Sons, New York).

**DE/PE2.9 MATERIAL HANDLING & PLANT LAYOUT**

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

**L T P**  
**3 1 0**

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.

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.

Safety Engg. - Safety in various shops, safety in critical storage area, storage explosive material, gases and inflammable liquids.

Importance of materials handling: Principles of material handling, analysis of material handling problem, operation and flow process charts, flow diagrams.

Material handling factors: Materials, containers frequency and duration, distance, speed, environment labour and equipment.

Factory planning and material handling: Plant location factory handling, the layout as key materials handling problem.

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,

Screw vibrating and reciprocating, pneumatic tubes, load transferring, machines, air operated ;and hydraulic devices.

Cranes, Elevators and Hoists; Industrial Trucks, dump trucks, overhead trackage system. Pallets and containers.

**BOOKS;**

1. Plant Layout and Material handling. J.M. Apple; Rjonald Press.
2. Plant Layout and Design, J.M.Moore.
3. Systematic Layout Planning, R.Mutter.
4. Plant Layout & Material handling, A.B.Chowdhary. Khanna Publishers.

**DE/PE-3.0 PRODUCTION PLANNING AND CONTROL**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

Elements:

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.

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.

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.

Scheduling:

Master schedule, departmental and shop schedule charts for scheduling. Gantt Charts- loading and scheduling, Sched-U-Graph. Boards for scheduling.

Despatching:

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 despatching, follow up.

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.

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.

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.

Computer Applications:

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

**Books:**

1. Production Management: F. G. Moore ; Richard D. Irwin
2. Production controls: John F. Biegel ; Prentic Hall
3. Production Planning Control &: K. C. Jain & N. L. Aggarwal ; Khanna Publishers Industrial Management.
4. Production / Operations Management : J. G. Monks
5. Modern Production Management : Elwood Buffa

**DE/ME-3.1 INDUSTRIAL SAFETY AND ENVIRONMENT**

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

**L T P**  
**3 1 0**

**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.

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.

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

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.

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.

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:**

1. Air Pollution Control, Rjossamo, McGraw Hill. .
2. Ventilation, Joselin, Edward Arnold.
3. Noise Reduction, Beranek, McGraw Hill.
4. Modern Safety & Health Technology, DC Reamer; R Wiley.
5. Industrial Accident prevention, Heinrich, H.W.: McGraw Hill.
6. The process of Hazard Control, Firenze, RJ; Kendale Hunt.

**DE/ME-3.2 ENTREPRENEURSHIP**

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

**L T P**  
**3 1 0**

**1. CONCEPT OF LENTREPRENEURSHIP:**

Entrepreneurship and small-scale industry, need for promotion of entrepreneurship, entrepreneurship development programmes (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:**

1. E.D.I. Ahmedabad, Publication regarding Entrepreneurship.
2. Project Preparation, Appraisal Budgeting and Implementation, Prasanna chandra, TMH.
3. Entrepreneurship, TTTI
- . 4. Entrepreneurial Development, C.S.Gupta & N.P.Srinivasan.
5. Entrepreneurship Development Practice & Planning, S.Chand.
6. Entrepreneurship of Small Scale Industries. M.U.Deshpanda C.B.I.