Revised scheme for B.Tech. (Mechanical)

3rd Semester B.Tech (Mechanical)

Code	Title of the course	L	T	P	Maximum Marks		Total Marks	Duration of Theory Examination (in Hours)
					Internal	External		
ME 201	Strength of Materials-I	3	1	-	40	60	**100**	**3**
ME-211	Strength of Materials Lab.	-	-	2	30	20	**50**	
ME 203	Theory of Machines-I	3	1	-	40	60	**100**	**3**
ME 205	Engineering Materials & Metallurgy	3	-	-	40	60	**100**	**3**
ME-213	Engineering Materials and Metallurgy Lab.	-	-	2	30	20	**50**	
ME 207	Machine Drawing	1	-	6	40	60	**100**	**4**
ME 209	Applied Thermodynamics - I	4	1	-	40	60	**100**	**3**
PE-209	Manufacturing Process – I	3	-	-	40	60	**100**	**3**
PE-217	Manufacturing Process – I Lab.	-	-	2	30	20	**50**	
ME 215	Workshop Training*	-	-	-	60	40	**100**	
	Advisory meeting			1				
	Total	**17**	**3**	**13**	390	480	**850**	

Total contact hours = 33

* Workshop Training will be imparted in the Institution at the end of second semester for 04 weeks duration (Six hours per day and six days a week). Industrial tour will also form part of this training.

The syllabus of ME-205 is same with ME-202 of 2002 batch.

4th Semester B.Tech (Mechanical)

Code	Title of the course	L	T	P	Maximum Marks		Total Marks	Duration of Theory Examination (in Hours)
					Internal	External		
AM 201	Mathematics-III	4	1	-	40	60	**100**	**3**
ME 202	Strength of Materials – II	3	1	-	40	60	**100**	**3**
ME 204	Theory of Machines – II	3	1	-	40	60	**100**	**3**
ME-212	Theory of Machines Lab	-	-	2	30	20	**50**	
ME 206	Fluid Mechanics –I	3	1	-	40	60	**100**	**3**
ME-214	Fluid Mechanics-I Lab	-	-	2	30	20	**50**	
ME 208	Applied Thermodynamics - II	3	1	-	40	60	**100**	**3**
ME-216	Applied Thermodynamics Lab	-	-	2	30	20	**50**	
ME 210	Manufacturing Process-II	3	-	-	40	60	**100**	**3**
ME-218	Manufacturing Process-II Lab	-	-	2	30	20	**50**	
	General Fitness				100	-	**100**	**-**
	Advisory meeting			1				
	Total	**19**	**5**	**9**	460	440	**900**	

Total contact hours =31

NOTE:- There shall be industrial training of 0 6 weeks duration in reputed industries at the end of 4th semester. The marks for this will be included in the 5th semester.

5th Semester B.Tech (Mechanical).

Code	Title of the course	L	T	P	Maximum Marks		Total Marks	Duration of Theory Examination (in Hours)
					Internal	External		
ME-301	Machine Design -I	3	1	-	40	60	**100**	**4**
ME-311	Machine Design Practice-I	-	-	2	30	20	**50**	
ME-303	Heat Transfer	4	1	-	40	60	**100**	**3**
ME-313	Heat Transfer Lab.	-	-	2	30	20	**50**	
ME-305	Automobile Engineering	3	-	-	40	60	**100**	**3**
ME-315	Automobile Engineering lab	-	-	2	30	20	**50**	
ME-307	Mechanical Measurement and Metrology	3	-	-	40	60	**100**	**3**
ME-317	Mechanical Measurement and Metrology Lab.	-	-	2	30	20	**50**	
ME-309	Numerical Methods in Engg	3	1	-	40	60	**100**	**3**
ME-319	Numerical Methods in Engg Lab	-	-	2	30	20	**50**	
ME-321	Computer Aided Drafting	-	-	2	30	20	**50**	
ME-323	**Industrial Training	-	-	-	60	40	**100**	
	Advisory meeting			1				
	Total	**16**	**3**	**13**	**440**	**460**	**900**	

Total Contact hours=32

** Industrial Training in reputed industries will be arranged for 6 weeks duration at the end of fourth semester.

6th Semester B.Tech (Mechanical)

Code	Title of the course	L	T	P	Maximum Marks		Total Marks	Duration of Theory Examination in Hours
					Int.	Ext		
ME-302	Machine Design-II	3	1	-	40	60	**100**	**4**
ME-310	Machine Design –II Practice	-	-	2	30	20	**50**	
ME-304	Refrigeration & Air Conditioning	4	1	-	40	60	**100**	**3**
ME-312	Refrigeration & Air Conditioning Lab	-	-	2	30	20	**50**	
ME-306	Fluid Machinery	3	1	-	40	60	**100**	**3**
ME-314	Fluid Machinery lab	-	-	2	30	20	**50**	
PE-408	Industrial Automation and Robotics	3	-	-	40	60	**100**	**3**
PE-414	Industrial Automation and Robotics lab	-	-	2	30	20	**50**	
CE-216	Environmental Science	3	1	-	40	60	**100**	**3**
-	Departmental Elective-I	3	1	-	40	60	**100**	**3**
-	Advisory meeting			1				
-	General Fitness	-	-	-			**100**	
	Total	**19**	**5**	**9**	460	440	**900**	

Total Contact hours=33

7th /8thSemester*					
	Course Title		**Internal**	**Ext.Viva**	**TOTAL**
	6-month Industrial Training		500	500	**1000**

7th / 8th Semester B.Tech (Mechanical)

Code	Title of the course	L	T	P	Maximum Marks		Total Marks	Duration of Theory Examination in Hours
					Int.	Ext.		
ME-402	Industrial Safety & Environment	3	-	-	40	60	**100**	**3**
ME-404	CAD/CAM	3	1	-	40	60	**100**	**3**
ME-410	CAD /CAM Lab	-	-	2	30	20	**50**	
ME-406	Operations Research	3	1	-	40	60	**100**	**3**
ME-408	Mechanical Vibrations	3	1	-	40	60	**100**	**3**
ME-412	Mechanical Vibrations Lab.	-	-	2	30	20	**50**	
-	Open Elective	3	-	-	40	60	**100**	**3**
-	Department Elective- II	3	1	-	40	60	**100**	**3**
ME-414	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 (For 2002 and 2003 Admission Batch students):

B.Tech (Mech)

Group-1

DE/ME-1.1 I.C Engines
DE/ME-1.2 Cryogenic Technology
DE/ME-1.3 Non Conventional Energy resources
DE/ME-1.4 Energy Conservation and Management
DE/ME-1.5 Fluid Mechanics-II
DE/ME-1.6 Solar Energy
DE/ME-1.7 Heat Exchanger Design
DE/ME-1.8 Power Plant Engg.
DE/ME-1.9 Gas Dynamics

Group-2

DE/PE-2.0 Non-Traditional Machining
DE/PE-2.1 Industrial Engg
DE/PE-2.2 Modeling and Simulation
DE/ME-2.3 Operations Management
DE/ME-2.4 Non -Destructive Testing
DE/ME-2.5 Total Quality Management
DE/ME-2.6 Maintenance and Reliability Engg
DE/ME-2.7 Material Management
DE/ME-2.8 Management Information System
DE/ME-2.9 Entrepreneurship

Group-3

DE/PE-3.0 Product Design and Development
DE/PE-3.1 Machine Tool Design
DE/PE-3.2 Network Analysis
DE/ME-3.3 Tool Design
DE/ME-3.4 Finite Element Method
DE/ME-3.5 Experimental Stress Analysis
DE/ME-3.6 Industrial Tribology
DE/ME-3.7 Theory of plasticity
DE/ME-3.8 Mechatronics

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

**

- **The syllabi of DE/PE-2.0 is same as the syllabi of PE-404.**
- **The syllabi of DE/PE-2.1 is same as the syllabi of PE-302.**
- **The syllabi of DE/PE-2.2 is same as the syllabi of PE-304.**
- **The syllabi of DE/ME-2.5 is same as the syllabi of ME-251.**
- **The syllabi of DE/PE-3.0 is same as the syllabi of PE-306.**
- **The syllabi of DE/PE-3.1 is same as the syllabi of PE-406.**
- **The syllabi of DE/PE-2.7 is same as the syllabi of DE/PE/2.7.**

ME-201 STRENGTH OF MATERIALS – I

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

1. Understand the concept of simple stress and strain.
2. Understand different types of direct stresses and strains.
3. Understand stress- strain diagram. Hookes law, Poisson's ratio. Young's Modulus of Elasticity.
4. Compute simple stresses and strains in bars of uniform and varying sections subjected to axial loads.
5. Derive relationship between the Elastic Moduli.
6. Compute stresses and strains in compound bars subjected to axial loads and temperature variations.
7. Compute combined stresses and strains at a point across any plane in a two dimensional system.
8. Understand the concept of principal planes and principal stresses.
9. Apply graphical and analytical methods to compute principal stresses and strain and locate principal planes.
10. Derive mathematically the Torsion Equation.
11. Apply the Torsion equation to compute torsional stresses in solid and hollow shafts.
12. Compute principal stresses and maximum shear stresses in circular shafts subjected to combined stresses.
13. Analyze stresses in close- coiled helical springs.
14. Analyze stresses in thin shells and spheres subjected to internal pressure.
15. Apply different formulae to analyze stresses in struts and columns subjected to axial loads.
16. Compute bending moments and shear forces at different sections of determinate beam structures subjected to different types of loading and sketch their distribution graphically.
17. Derive mathematically the relationship between the rate of loading, shear force and bending moment at any section of a beam.
18. Understand the theory of simple bending.
19. Apply the theory of simple bending to compute stresses in beams of homogenous and composite sections of different shapes.
20. Derive relationship between moment slope and deflection.
21. Use the above relationship and other methods to calculate slope and deflection in beams.
22. Compute stresses in determine trussed frames and roof trusses.

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:
a) Concentrated loads
b) Uniformity distributed loads over the whole span or part of span
c) Combination of concentrated loads (two or three) and uniformly distributed loads
d) Uniformity varying loads
e) 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 and channel, I & T- sections,: Combined direct and bending stresses in aforementioned sections, 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 formuls; 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 2nd 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; Khanna book Publishing Company, New Delhi.
7. Strength of materials by R.S Lehri and A.S. Lehri, S.K Kataria and Sons.

ME-211 STRENGTH OF MATERIALS LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

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.

ME-203 THEORY OF MACHINES-I

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

1. Understand the basic concepts of machines and mechanisms.
2. Understand/ compute the velocity and acceleration diagrams of all basic mechanisms.
3. Draw velocity and acceleration diagrams of basic link mechanism.
4. Understand turning moment and crank effort diagram.
5. Understand the types of lower pairs.
6. Understand the types of cam & follower.
7. Understand the types of drives such as: belts, ropes and chains.
8. Derive the relationship between tension on tight and slack sides of belts and HP transmitted by the belt.
9. Understand different types of brakes and dynamometers.
10. Applied different formulae to compute problems on brakes.
11. Understand the functions, types and characteristics of governors.
12. Apply the theory of governors to solve numerical problems.

Detailed Contents

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, Graphical (relative velocity vector and instantaneous center methods) and Analytical methods for finding: Displacement, velocity, and acceleration of mechanisms (including Corliolis components).

2. Lower Pairs: Universal joint, calculation of maximum torque, steering mechanisms including Ackerman and Davis approximate steering mechanism, engine indicator, Pentograph, Straight line mechanisms

3. Belts, Ropes and Chains : Material, types of drives, idle pulley, intermediate or counter shaft pulley, angle and right angle drive, quarter turn drive, velocity ratio, crowning shaft pulley, loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack sided of belts, HP transmitted by belts including consideration of creep and slip, centrifugal tensions and its effect on HP transmitted. Use of gravity, idle, flat, V-belts and rope materials. Length of belt, rope and chain drives, type and cone type.

4. Cams: Types of cams and follower, definitions of terms connected with cams, displacement velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform acceleration and retardation, cycloidal). Analysis of follower motion for circular convex, tangent cam profiles. Calculation of pressure angle.

5. Friction Devices: Concepts of frictions and wear related to bearing and clutches. Types of brakes, principle of function of brakes of various types. Braking of front and rear tyres of a vehicle, Problems to determine braking capacity, Types of dynamometers,(absorption, transmission).

6. Flywheels: Turning moment and crank effort diagrams for reciprocating machines Fluctuations of speed, coefficient of fluctuation of speed and energy, Determination of flywheel mass and dimensions for engines and Punching Machines

7. Governors : Function, types and characteristics of governors, Watt, Porter and Proell governor. Hartnell and Willson-Hartnell, spring loaded governors. Simple numerical problems on these governors. Sensitivity, stability, isochronisms and hunting of governors. Governor effort and power controlling force curve, effect of sleeve friction.

Books

1. Jagdish Lal, Theory of Mechanisms & Machines, Metropolitan Book Co. Pvt. Ltd, New Delhi.
2. S. S. Rattan, Theory of Machines, Tata McGraw Hill, New Delhi
3. Thomas Beven, Theory of Machines, Longman's Green & Co., London
4. W. G. Green, Theory of Machines, Blackie & Sons, London
5. Shigley , Theory of Machines, Mcgraw Hill , New York

ME-205 ENGINEERING MATERIALS & METALLURGY

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Detailed Syllabus

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) nuclear formation (crystal growth) (ii) crystal imperfection Elementary treatment of theories of plastic deformation, phenomenon of slip twinning, dislocation, identification of crystallographic possible slip planes and direction in FCC, BCC, C.P., recovery, re-crystallization, preferred orientation causes and effects on the property of metals.
2. Introduction to Engineering materials, their mechanical behaviour, 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 componenets 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 in which the solid state solubility deceases 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 (Si, Mn. Ni. Cr. Mo. Wc. Al) on the structures and properties of steel. Composition of alloy steels.

BOOKS

1. Engg. Physical Metallurgy Y. Lakhin, Mir Publishers
2. Heat treatment of metals B. Zakharv
3. Engineering Metallurgy V. Raghavan

ME-213 ENGINEERING MATERIALS & METALLURGY LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

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) Hypoeutectic cast iron and hyper eutectic cast iron.
iii) Grey and white cast iron
iv) Non – ferrous metals i.e. Al. Mg. Cu. Ni. Son. 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 minimum 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, cyaninding etc.
11. To study and construct the T-T- T diagram for steels.

ME-207 MACHINE DRAWING

Internal Marks: 40 **L T P**
External Marks: 60 **1 0 6**
Total Marks: 100
Examination Hours: 04

Course Objectives

1. Understand the principles and requirements of production drawings.
2. Understand the various symbols used in drawing.
3. Assemble and disassemble the following manually and using computer aided drafting :-

a) Various types of couplings
b) Pipe fittings
c) Boiler mountings
d) Types of bearings
e) Few machine tool parts
f) Screw jack and drill press vice

4. Use bill of materials in each of the above drawings.
5. Record the surface finish of the parts and reason as well as interpretation of drawing.

Detailed Contents

1. Principles of drawing, requirements of production drawing, , sectioning and conventional representation, dimensioning, symbols of standard tolerances, machining symbols, Introduction and familiarization of the code IS:296.
2. FASTENERS : Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints
3. Assembly and Dis-assembly of the following manually and using computer aided drafting.

a) Couplings: Solid or rigid Coupling, Protected type flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.
b) Knuckle and cotter joints
c) Pipe and Pipe fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint
d) IC Engine Parts : Piston, connecting rod
e) Boiler Mountings : steam stop valve, feed check valve, safety valve, blow off cock.
f) Bearings : swivel bearing, thrust bearing, plummer block, angular plumber block
g) Miscellaneous : Screw Jack, Drill Press Vice, Crane hook.

4. Drafting of simple mechanical components on computer.

NOTE :
Drawing Practice is to be done as per IS:296 code.
First angle projection to be used. Drawings should contain bill of materials and should
illustrate 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. Text-book of Machine Drawing by V Lakshmi Narayanan and Mathur
2. Machine Drawing by PS Gill, BD Kataria and Sons, Ludhiana
3. Machine Drawing by ND Bhatt, Charotar publications
4. Machine Drawing by N Sidheshwar, Tata McGraw Hill

ME-209 APPLIED THERMODYNAMICS-I

Internal Marks: 40 **L T P**
External Marks: 60 **4 1 0**
Total Marks: 100

Course Objectives

1. Understand the types of steam generators, boiler mountings and accessories.
2. Compute boiler performance.
3. Understand the theory of Rankine cycle.
4. Apply the theory of Rankine cycle to solve numerical problems.
5. Understand various types of nozzles and their utility.
6. Derive the formulae for critical pressure and discharge and nozzle efficiency.
7. Apply the above formulae to solve simple numerical problems.
8. Understand the constructional details of impulse steam turbine.
9. Understand the theory of impulses turbine.
10. Compute impulse turbine performance using above theory.
11. Understand the working of rejection turbine.
12. Derive blade efficiency and calculate blade height.
13. Understand methods of attachment of blades to turbine rotor.
14. Understand the losses, labyrinth packing and governing of steam turbines.
15. Understand the functions, constructional details of various types of condensers.
16. Apply Dalton's law to solve numerical problems.
17. Compute condenser performance parameters.
18. Understand effect of air leakage and its prevention in condensers.
19. Understand the use of compressed air and types of air compressors.
20. Study the operation of single and multi stage reciprocating compressors and compute their performance parameters.

Detailed Contents

1. **Combustion:** Combustion problems in boiler and IC Engines, Stoichimetric (or Chemically) air fuel ratio, analysis of products of combustion, conversion of volumetric analysis into gravimetric analysis and vise-versa, actual weight of air supplied, use of mols. For solution of combustion problems.
2. **Properties of Steam and Steam Generators**:
Pure substance constant pressure formation of steam, steam tables , constant volume, constant pressure and isentropic processes, simple Rankine cycle. Steam Generators Classification, Fire and water tube boilers; Description of Cochran, Locomotive, Lancashire, Babcock and Wilcox boilers, Stirling Boiler, mountings and accessories; Economiser, super heater etc. Modern high pressure boilers. Characteristics of high pressure boilers, Advantages of forced circulation, steam accumulators, boiler performance-equivalent evaporation, boiler efficiency.
3. **Rankine Cycle:**
Simple, methods of improving efficiency, Feed water heating (Bleeding), reheat cycle, combined reheat regenerative cycle, Ideal working fluid – Binary vapour cycle , combined power and heating cycles.
4**. Nozzle:**
Types and utility of nozzles, Flow of steam through nozzles, Critical pressure and discharge, Area of throat and exit for maximum discharge, Effect of friction, Nozzle efficiency, Supersaturated flow.
5. **Impulse Steam Turbines:**

General description, Pressure and velocity compounding, Velocity diagram and work done, Effect of blade friction on velocity diagram, Stage efficiency and overall efficiency, Reheat factor and condition curve.

6. **Reaction Turbines:**

Degree of reaction, velocity diagrams; Blade efficiency and its derivation; calculation of blade height; back pressure and extraction turbines and congeneration; Economic assesment.

Methods of attachment of blades to turbine rotor; losses in steam turbines; Governing of steam turbines; Labyrinth packing.

7. **Condensers**:

Function Elements of condensing plant. Different types, Dalton's law of partial pressures applied to condenser problems; condenser and vacuum efficiencies. Cooling water calculations.

Effect of air leakage, Methods to check and prevent air infiltration. Description of air pump and calculation of its capacity.

8. **Reciprocating Air Compressors**

Use of compressed air in industry. Classification of air compressors, Operation of single stage reciprocating compressors, Work input and the best value of index of compression, Isothermal and polytropic efficiency.

Books

1. Heat Engineering by Dr Vasandani and Dr Kumar; Metropolitan Book Co. Pvt. Ltd., Delhi
2. Thermal Engineering by PL Ballaney; Khanna Publishers, Delhi
3. Engineering Thermodynamics: Work and Hest Transfer By Rogers and Mayhew; ELBS Publications
4. Thermodynamics and Heat Engines Vol. I and II by R Yadav; Central Publishers, Allahabad
5. Steam Turbine Theory and Pratice by WAJ Keartan, ELBS Series
6. Applied Thermodynamics by TD Eastop & A Mc Conkey, ELBS Publications

PE-209 MANUFACTURING PROCESS –I

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

CASTING PROCESSES

Introduction to metal casting types of patterns, their materials and allowances.
Moulding materials: Moulding sand compositions and moulding sand properties, sand testing types of moulds, moulding machines cores core sands, types of cores, core banking elements of gating system, 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 copper alloys.
Cleaning and finishing of castings, Testing and Inspecting of castings.

WELDING

Welding introduction and classification of welding, processes, welding terminology, general principles, welding positions, filler metals.
Gas welding and gas cutting, principle, oxyacetylene welding equipment oxyhydrogen
welding. Flame cutting.
Electric are welding. Principle, equipment, types- MIG, TIG submerged arc and others.
Welding electrodes, classification and selection of electrodes, welding arc and its characteristics, arc stability, arc blow. 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 are welding electron beam welding, atomic hydrogen hydrogen welding. Basic considerations in joint design,
Welding defects, their cases and remedies.
Brazing, braze welding and soldering.

Books

1. Heine, R.W. C.R. Loper and P.C. Rosenthal, Principles of metal casting Mc Graw Hill New York- 1967
2. Welding Technology by R.S. Parmar, Khanna Publishers.

PE-217 MANUFACTURING PROCESS – I Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

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 moulding sand in dry condition.

7. Determination of permeability of a moulding sand sample.

8. Measurement of grain finances number.

9. To study various features of cupola furnace and its charges calculations.

10. Prepare a green sand mould for any stable engg. component.

WELDING PRACTICALS

1. Specimen preparation and making of lap joint, Butt, T- joints with oxy- acetylene 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 in this process.

4. Study of TIG welding equipment and making a weld joint in 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 generators welding torch etc.

7. To study the resistance welding processes and prepare welded joint.

4th Semester

AM-201 MATHEMATICS-III

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Detailed Contents

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.
2. Laplace Transforms Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications
to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.
3. Special Functions Power series solution of differential equations, Frobenius method, Legendre's equation, Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, equations reducible to Bessel's equation, Error function and its properties.
4. Partial Differential Equations Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients Applications: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation, solution by the method of separation of variables. Laplacian in polar coordinates.
5. Functions of Complex Variable Limits, continuity, derivative of complex functions,
analytic function, Cauchy-Riemann equation, conjugate functions, harmonic functions; Conformal Mapping: Mapping of a complex function, conformal mapping, standard transforms, mapping of standard elementary transformations, complex potential, applications to fluid flow problems; Complex Integration : Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions, singular points, poles, residue, complex integration using the method of residues, evaluation of real integrals by contour integration.

Books

1. Advanced Engineering Mathematics by Kreyszing Erwin ; Wiley Eastern, New Delhi
2. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.
3. Numerical Solutions of Differential Equations by NK Jain ; Prentice Hall, Delhi.
4. Differential Equations by Sharma and Gupta ; Krishna Prakashan Media (P) Ltd., Meerut.

ME-202 STRENGTH OF MATERIALS-II

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

1. Understand the concepts of strain energy.
2. Understand resilience stress developed due to suddenly applied loads.
3. Understand Castigliano's & Maxwell theorems.
4. Understand the various theories of failure.
5. Derive equations and graphically represent each of the above.
6. Apply theories of failure to problems in 2D stress systems.
7. Derive the general formula for distribution of shear stress in beams.
8. Apply the above formula to various cross sections of beams.
9. Calculate deflection and reaction of indeterminate beams subjected to various kinds of loads.
10. Draw SF and BM diagrams for each of the above.
11. Derive mathematically Lame's equation.
12. Compute various type of stresses and strain developed due to internal pressure in types of cylinders.
13. Compute stresses in cranks, rings of various section and chain links.
14. Solve simple numerical problems on the above.

Detailed Contents

1. Strain energy, energy of dilation and distortion, resilience stress due to suddenly applied loads, Castigliano's theorem, Maxwell's theorem of reciprocal deflection.
2. Theories of Failure : Maximum principal stress theory, maximum shear stress theory, Total strain energy theory, shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two dimensional stress systems only.
3. Leaf spring, deflection and bending stresses; open coiled helical springs; derivation of formula and application for deflection and rotation of free end under the action of axial load and/or axial couple; flat spiral springs – derivation of formula for strain energy, maximum stress and rotation.
4. Thick Cylinders : Derivation of Lame's equations, calculation of radial longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts.
5. Bending of curved beams : Calculation of stresses in crane or chain hooks, rings of circular section and trapezoidal section and chain links with straight sided;
6. Shear stress distribution in rectangular, circular,I,T and channel section and the compression with bending stresses, Importance of shear centre.
7. Rotational stresses in discs and rims of uniform thickness; discs of uniform strength

Books

1. Elements of Strength of Materials by Timoshenko and Gere
2. Advanced Soild Mechanics by LS Srinath
3. Advanced Mechanics of Materials by Seely and Smith
4. Strength of Materials by GH Ryder
5. Mechanics of Materials-I by EJ Hern; Paragaman, New York
6. Introduction to Mechanics of Solids by Crandell, Dahl and Lardner, McGraw Hill
7. Strength of Materials DS Bedi
8. Mechanics of Materials by Dr.Kirpal Singh, Standard Publishers & Distributors.
9. Strength of Materials by R.S. Lehri, S.K Kataria and Sons

ME-204 THEORY OF MACHINES – II

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

1. Compute, both analytically and graphically forces and couples for reciprocating parts and dynamically equivalent system.
2. Understand the theory of inertia force and apply to four-bar linkage mechanism.
3. Understand types of balancing and its need.
4. Apply the theory of balancing to reciprocating and Rotating masses.
5. Understand the types of both tooth gear and the nomenclature of gears.
6. Understand the concepts of interference in gears, and its removal.
7. Compare the cycloid and involute tooth profile.
8. Understand the various types of gear trains.
9. Apply the theory of gear trains to solve simple numerical problems.
10. Understand gyroeffect on moving bodies
11. Understand techniques of kinematic synthesis

Detailed Contents

1. Static force analysis: Static equilibrium of mechanism, concept of force and couple,
free body diagram, condition of equilibrium, methods of static force analysis of simple mechanisms and power transmission elements, considerations of frictional forces
2. Determination of forces and couples for a crank, inertia of reciprocating parts, dynamically equivalent system, analytical and graphical method, inertia force analysis of basic engine mechanism torque required to overcome inertia and gravitational force of a four bar linkage.
3. Balancing: Classifications, need for balancing, balancing of single and multiple rotating masses, static and dynamic balancing, primary and secondary balancing for reciprocating masses, partial balancing of locomotives, swaying couple, hammer blow, variation in tractive effort, balancing of V-engine, concept of direct and reverse crank, balancing of machines, rotors, reversible rotors.
4. Gears : 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. Calculation of minimum no of teeth on pinion/wheel for involute rack, helical/spiral/bevel/worm gears. Center distance for spiral gears and efficiency of spiral gears
5. Gear Trains : Types of gear trains, simple, compound and epicyclic gear trains, problems involving their applications, estimation of velocity ratio of worm and worm wheel.
6. Gyroscopic motion and gyroscopic couples: Effect on supporting and holding structures of machines, Effect on 2 and 4 wheeled vehicles,
7. Kinematic synthesis of Mechanism: Freudenstien equation, Function generation errors in synthesis, two/three point synthesis, Transmission angles, least square techniques,

Books

1. Theory of Machines by PL Ballaney
2. Theory of Machines by Hams Crone and Roggers
3. Theory of Machines by Shigley, Mc Graw Hill, New Delhi
4. Theory of Machines by Dr. Jagdish Lal
5. Theory of Machines by SS Rattan,Tata Mc. Graw Hill, New Delhi
6. Theory of Mechanisms and Machines by Ghosh and Mallick, Affiliated East West Pvt.Ltd

ME-212 THEORY OF MACHINES Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Study of various links and mechanisms.
2. Study and draw various inversions of 4- bar chain and single slider crank chain.
3. Draw velocity and diagram of engine mechanism using graphical methods including Klien's construction.
4. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
5. Determination of gyroscopic couple (graphical method).
6. Balancing of rotating masses (graphical method)
7. Determination vibration characteristics of free and forced spring mass system with and without damping.
8. Cam profile analysis (graphical method)
9. Determination of gear- train value of compound gear trains and Epicyclic gear trains.
10. Study pressure distribution in a full journal bearing.

ME-206 FLUID MECHANICS-I

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Purpose

This is a core subject, basic knowledge of which is required by all the engineers. This course aims at developing an understanding of the behaviour of fluids in motion or at rest and the subsequent effects of the fluids on the boundaries. The study of this subject
will develop analytical abilities related to fluid flow.

Instructional Objectives

The students should be able to have:
1. Conceptual understanding of fluids and their properties.
2. Understanding of fluid statistics, fluid kinematics and fluid dynamics.
3. Basic knowledge of dimensional analysis and similitude.
4. Understanding of laminar and turbulent flows, and flow measurement.

Detailed Contents

1. Fluid and their properties : Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; capillarity, vapour pressure, compressibility and bulk modulus; Newtonian and non- Newtonian fluids.
2. Fluid Statics: Concept of pressure, Pascal's law and its engineering applications, Hydrostatic paradox.
Action of fluid pressure on a plane (horizontal, vertical and inclined) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure.
Buoyancy and flotation, stability of floating and submerged bodies, metacentric height and its determination, periodic time of oscillation, pressure distribution in a liquid subjected to constant horizontal/ vertical acceleration, rotation of liquid in a cylindrical container.
3. Fluid Kinematics : Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration, streamline, path line and streak line, flow rate and discharge mean velocity, continuity equation in Cartesian and cylindrical, polar coordinates.
Rotational flows, rotation velocity and circulation, stream and velocity potential functions, flow net.
4. Fluid Dynamics : Euler's equation, Bernoulli's equation and steady flow energy equation; representation of energy changes in fluid system, impulse momentum equation, kinetic energy and momentum correction factors, flow along a curved streamline, free and forced vortex motions.
5. Dimensional Analysis and Similitude : Fundamental and derived units and dimensions, dimensional homogeneity. Rayleigh's and Buckingham's Pi method for dimensional analysis. Dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies.
Laminar and Turbulent Flows: Flow regimes and Reylods number, critical velocity and critical Reynolds number, laminar flow in circular cross- section pipes. Turbulent flows and flow losses in pipes, Darcy equation, minor head losses in pipes and pipe fittings, hydraulic and energy gradient lines.
6. Flow Measurement: Manometers, pitot tubes, venturi meter and orifice meters, orifice, mouthpieces, notches and weirs, rotameter.

Books

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar : S.K. Kataria and Sons Publishers.
2. Mechanics of Fluids by Massey BS; Van Nostrand Reinhold Co.
3. Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Poitman
4. Fluid Mechanics by Streetes VL and Wylie EB; Mcgraw Hill Book Co.

ME-214 FLUID MECHANICS- I Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.

2. To study the flow through a variable area duct and verify Bernoulli's energy equation.

3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)

4. To determine the discharge coefficient for a Vee- notch or rectangular notch.

5. To study the transition from laminar to turbulent flow and to ascertain the lower critical Reynolds number.

6. To determine the hydraulic coefficients for flow through an orifice.

7. To determine the friction coefficients for pipes of different diameters.

8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.

9. To determine the velocity distribution for pipeline flow with a pitot static probe.

Instructional Approach
The laws, concepts and principles will be taught lecture- cum- discussion.
The elaboration of the laws, concepts of principle will be done through numerical examples.
The numerical problems will be solved in the classroom lectures and tutorials for practice the application of laws, concepts and principles will be taught through lecture- cum- discussion.
The theory taught will be reinforced through conduct of practical in the laboratory.

ME-208 APPLIED THERMODYNAMICS – II

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Detailed Contents

IC Engines
Classification. Two stroke and four stroke engines, rotary engines and their comparison, Principle of Carburation, Essential requirements for petrol and diesel fuels ; R.A.C. rating of petrol engines, Theory of combustion in SI and CI engines, pressure time diagram, various phenomenon such as turbulence squish and swirl, dissociation and pre ignition, Theory of detonation (knocking) for SI and CI engines, effect of engine variables on Delay period in SI and CI Engines, effect of various engine parameters on knock (detonation) in SI and Diesel engines ; effect of detonation on engine performance and methods employed to reduce detonation. Octane and Cetane rating of fuels, octane and cetane number knockmeter and doping of fuels. Combustion chambers and cylinder heads for SI and CI engines. Methods of governing and cooling of IC Engines. Performance curves of SI and CI engines, performance maps, effect of compression ration and of air fuel ratio on power and efficiency of an engine. Variation of engine power with altitude ; supercharging its advantages and application ; supercharging of IC engines ; types of superchargers. High speed engine indicators, logarithmic plotting of PV diagrams

Rotary Compressors
Introduction and general classification of rotary compressors; comparison of rotary compressors with reciprocating processors; operation of positive displacement type of rotary compressors like roots blower, Lysholm compressor and Vane type Blower. Applications of Steady Flow Energy Equation and thermodynamics of Rotary compressors; stagnation and static values of pressure, temperature and enthalpy etc. for flow through rotary machines. Complete representation of compression process on T-S coordinates with detailed
description of areas representing total work done and Polytropic work done, area representing energy lost in internal friction, energy carried away by cooling water etc. on T-S coordinates for uncooled and cooled compression, Isentropic, polytropic and isothermal efficiencies as ratios of areas representing various energy transfers T-S coordinates.

Centrifugal Compressors
Complete thermodynamic anlysis of centrifugal compressor stage, polytropic, isentropic and isothermal efficiencies; complete representation of compression process starting from ambient air to flow through suction pipe, impeller, diffuser and finally to delivery pipe on T-S coordinates; preguide vanes and prewhirl; Slip factor, power input factor; various modes of energy transfer in impeller and diffuser; Degree of reaction and its derivation; energy transfer in backward, forward and radial vanes; pressure coefficient as a function of slip factor, efficiency and outcoming velocity profile from the impeller.
Derivation of non-dimensional parameters for plotting compressor characteristics; centrifugal compressor characteristics curves; surging and choking in centrifugal compressors.

Axial Flow Compressors
Different components of axial flow compressors and their arrangement; discussion on flow passages and simple theory of aerofoil blading; angle of attack; coefficients of lift and drag; turbine versus compressor blades; velocity vector vector diagrams, thermodynamic analysis and power calculations; modes of energy trasfer in rotor and stator blade flow passages. Detailed discussion on work done factor; Degree of

reaction and Blade efficiency and their derivations; Isentropic, polytropic and Isothermal Efficiencies.
Surging, choking and stalling in axial flow compressors, characteristics curves for axial flow compressor, flow parameters of axial flow compressor like pressure coefficient, flow coefficient, work coefficient and temperature rise coeffieicnt specific speed etc.
Comparison on axial flow compressor with centrifugal compressor and reaction turbine; field of application of axial flow compressors.

Gas Turbines
Comparison of open and closed cycles; comparison of gas turbine with a steam turbine and IC engine. Fields of application of gas turbine.
Position of gas turbine in power industry; classification on the basis of system of operation (open and closed cycles) and on the basis of combustion (at constant volume or constant pressure)
Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; cycle air rate, temperature ratio; effect of changes in specific heat and of mass of fuel on power and efficiency; Operating variables and their effects on thermal efficiency and work ratio.
Thermal refinements and their effects on gas turbine cycle i.e. gas turbine cycle with regeneration, intercooling and reheating; multistage compression and expansion; Dual Turbine system; Series and parallel arrangements, closed and semiclosed gas turbine cycle; requirements of a gas turbine combustion chamber. Blade materials and selection criteria for these materials and requirements of blade materials. Gas turbine fuels.

Jet propulsion
Principle of jet propulsion, description of different types of jet propulsion system like Rockets and thermal jet engines like (I) athodyds (ramjet and pulsejet), (ii) turbojet engine, (iii) turboprop engine. Thermodynamics of turbojet engines components; development of thrust and methods for its boosting/augmentation; thrust work and thrust power, propulsion energy, propulsion and thermal (internal) efficiencies, overall thermal efficiency. Specific fuel consumption.
Rocket propulsion, its thrust and thrust power; propulsion and overall thermal efficiency, types of rocket motors (e.g. solid propellant and liquid propellant systems); various common propellant combinations (i.e. fuels) used in rocket motors; cooling of rockets
Advantages and disadvantages of jet propulsion over propulsion systems; Brief introduction to performance characteristics of different propulsion systems; fields of application of various propulsion units.

Books
1. Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Co. Pvt Ltd., Delhi
2. Thermodynamic and Heat Engines, Vol II by R Yadav
3. Principles of Turbomachinery by DG Shephered
4. Gas Turbine Theory by Cohen H and Rogers GFC and Sarvan matto; Longmans
5. An Introduction to Energy Conversion by V Kadambi, Manohar Prasad; Wiley International, New Delhi
6. IC Engines by ML Mathur and RP Sharma; Dhanpat Rai and Sons
7. Fundamentals of IC Engines by Heywood; McGraw Hill

ME-216 APPLIED THERMODYNAMICS- II Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. To Study 2 stroke and 4 stroke Petrol and Diesel engines

2. To draw valve timing diagram of a diesel engine and study of its impact on the performance of an IC Engine.

3. Study of various circuits of a carburetor fitted on Indian Make Vehicle.

4. Study of various types of Boilers, Boiler trial: Estimation of equivalent evaporation and efficiency of a fire tube/ water tube boiler.

5. Determination of dryness fraction of steam and estimation of brake power, Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of a steam engine/ steam turbine unit and plotting of William line.

6. Determine the brake power, indicated power, friction power and mechanical efficiency of a multicylinder petrol engine running at constant speed (Morse Test).

7. Performance of a diesel/ semi diesel engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and SFC (Specific fuel consumption) and further obtain power consumption curves and draw the heat balance sheet.

8. Performance of single stage/ multi stage reciprocating compressor.

ME-210 MANUFACTURING PROCESSES-II

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Detailed Contents

1. Metal Forming

Introduction : Classification of forming processes,

Rolling : Classification of rolling processes, rolling mills, products of rolling and main variables, rolling defects,

Drawing : Drawing of rods, wires and tubes, Draw benches, main variables in drawing operations.

Forging : Open and closed die forging, forging operations, hammer forging, press forging and drop forging, forging defects, their causes and remedies.

Extrusion : Classification of extrusion processes, extrusion equipment, variables in extrusion process.

Introduction to high velocity forming.

Sheet metal forming operations : Spinning, deep drawing, bending.

Introduction to press working. Types of presses, press working operation, Press working tools.

Introduction to powder metallurgy, methods of producing powders, briquetting and sintering, sizing and finishing operations,

2. Metal cutting and Machine tools

Cutting tool materials, high carbon steels, alloy carbon steels, high speed steel, cast alloys, cemented carbides, ceremics and diamonds, CBN etc. Geometry of single point cutting tools, Twist Drill and milling cutter, cutting speeds and feeds

Coolants: Classification, purpose, its effect on speed and feed

Lubricants: Function and properties

Lathe: Machine and its accessories, Lathe operations, Turning, Taper Turning and Thread cutting, kinematic scheme of lathe, shaping and planing Machine, Drive Mechanisms, slotting machine, cutting speeds and feeds

Milling machine and its classification, upmilling and down milling

Indexing: Simple compound and differential

Sawing Machine and Drilling Operation

Boring Operation and boring machines

Grinding: Cylindrical, surface and centreless grinding

Composition and nomenclature of grinding wheels

Introduction to broaching machine

Books

1. Manufacturing Technology: Foundry, Forming and Welding by Rao, Tata McGraw Hill, New Delhi.
2. Principles of Manufacturing Materials and Processes by J.S. Campbell, Tata McGraw Hill.
3. Metal forming fundamentals and applications by Alton.

ME-218 MANUFACTURING PROCESSES-II LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Study of constructional features of following machines through drawings/ 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
j) Draw Bench
k) Drawing, Extrusion Dies
l) Rolling Mills

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 planner.

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, cutter and drills.

7. Study of recommended cutting speeds for different tool- work material combinations.

8. Identification of different cutting tool and work materials.

5th Semester

ME-301 MACHINE DESIGN-1

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100
Examination Hrs: 04

Objectives

1. Understand the meaning of machine design and basic design process
2. Understand the various types of machine design processes
3. Developing creativity for design
4. Co-relating the basic machine design with the of product design process
5. Developing the capability to analyse and select the various criteria of design
6. To be able to segregate components and design them independently.
7. Predict effectively and accurately the reasons of failure and then correlate it to the theoretical knowledge.
8. To learn various design consideration like stress concentration factor, factor of safety etc.
9. Design of various types of fasteners including riveted joints, bolted joints and welded joints under various loading conditions.
10. Design of transmission shafts subjected to torque, bending and axial loading
11. Design various kinds of keys for both shearing and crushing
12. Design rigid and flexible coupling for torque transmission
13. Learning of basic design of links and levers
14. Designing of some of the pipe joints

Detailed Contents

1. Meaning of design with special reference to machine design. Definition and understanding of various types of design, Elaborated Design process

2. Design and creativity ; Systematic design conceptualization, product design definition, underlying principles of design in Aesthetics and ergonomics, free body diagram for components design

3. General Design Considerations:

a) Concept of tearing, bearing, shearing, crushing, bending etc.

b) Selection of materials, Basic criteria of selection of material, their designation, mechanical properties of those materials in brief.

c) Study of Stress concentration, factor of safety under different loading conditions,

3. Basic Design:

Design for static loading, design for variable loading for both limited and unlimited life, concept of fatigue and endurance strength.

4. Design of fasteners:

a) RIVETS: Desing of rivets for boiler joints, lozenge joints (uniform strength joint), eccentrically loaded riveted joints

b) BOLTS: Understanding the various stresses/ failure in bolted joints, design of cylindrical covers, basic and eccentrically loaded bolts

c) WELDS: Design for various loading conditions in torsion, shear or direct load, eccentrically loaded welded joints.

d) MISCELLENEOUS: Design of spigot and socket cotter joint, Gib and Cotter joint and knuckle joint.

5. Design of Transmission Shaft

Design of both solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for critically speed, Design of shaft for rigidity and Design of stepped shafts for assembly

6. Design of Keys and Couplings:

Design of sunk keys under crushing and shearing, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint

7. Lever design:

Basic lever design, design of foot and hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever

8. Design of Pipe Joints:

Stresses in pipe joints, design of circular flange pipe joint, oval flanged pipe joints, square flange pipe joint

Books

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinal, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Khurmi
6. Machine Design by Goyal and Bahl, Standard Publishers
7. Product Design and Development, Prentice Hall
8. Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

Note: Design data book is not allowed in examination.

ME 311 MACHINE DESIGN -1 PRACTICE

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

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 joints

    And justify your findings

4. Find a flange coupling in the college laboratory and justify its design by actual measurements

5. Design a shaft used in some practical application, by actual working and loading conditions

6. Select a braking system lever (both hand and foot lever) and justify the design parameters

7. Justify the design of single plate clutch of a engine assembly

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

ME-303 HEAT TRANSFER

Internal Marks: 40 **L T P**
External Marks: 60 **4 1 0**
Total Marks: 100

1. Introduction

Concept of heat transfer, Difference between the subject of "Heat Transfer" and its parent subject "Thermodynamics". Different modes of heat transfer - conditions, convection, radiation.

2. Conduction

Fouier's law of heat conduction, coefficient of thermal conductivity, effect of temperature and pressure on thermal conductivity of solids, liquids and gases and its measurement.

Three-dimensional general conduction equation in rectangular, cylindrical and spherical coordinates involving internal heat generation and unsteady state conditions. Derivation of equations for simple one dimensional steady state heat conduction from three dimensional equations for heat conduction though walls, cylinders and spherical shells (simple and composite), electrical analogy of the heat transfer phenomenon in the cases discussed above.

Equivalent areas, shape factor, conduction through edges and corners of walls and critical thickness of insulation layers on electric wires and pipes carrying hot fluids. Internal generation cases along with some practical cases of heat conduction like heat transfer through underground electrical cables, simple model of heat conduction through piston crown and case of nuclear fuel rod with cladding.

Influence of variable thermal conductivity on conduction through simple cases of walls / cylinders and spheres. Introduction to unsteady heat transfer, Newtonian heating and cooling of solids; definition and explanation of the term thermal diffusivity.

3. Theory of Fins

Straight rod type of fins of uniform cross-section; e.g. of circular, rectangular or any other cross-section). Straight fins with varying cross-sectional area and having triangular or trapezoidal profile area, circumferential find of rectangular cross-section provided on the circumference of a cylinder.

Optimum design of straight find of rectangular and triangular profile cross-sections; fin effectiveness and fin efficiency for straight rod fins of rectangular and circular cross-section. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement.

4. Convection Free and forced convection, derivation of three-dimensional mass, momentum and energy conservation equations (with introduction to Tensor notations).

Boundary layer formation, laminar and turbulent boundary layers (simple explanation only and no derivation).

Theory of dimensional analysis as applied to free and forced convective heat transfer. Analytical formula for heat transfer in laminar and turbulent flow, flow over vertical and horizontal tubes and plates.

Newton's law of cooling. Overall coefficient of heat transfer. Different design criterion for heat exchangers. Log mean temperature difference for evaporator and condenser tubes, and parallel and counter flow heat exchangers. Calculation of number and length of tubes in a heat exchanger.

5. Convection with Phase Change (Boiling and Condensation)

Pool boiling, forced convection boiling, heat transfer during pool boiling of a liquid. Nucleation and different theories of nucleation, different theories accounting for the increased values of h.t.c. during nucleate phase of boiling of liquids; different phases of flow boiling (theory only)

6. Radiation

Process of heat flow, definition of emissivity, absorptivity, reflectivity and

transmissivity. Concept of black and grey bodies, Plank's law of nonchromatic radiation. Kirchoff's law and Stefan Boltzman's law. Interchange factor. Lambert's Cosine law and the geometric factor. Intensity of Radiation (Definition only), radiation density, irradiation, radiosity and radiation shields.

Derivation formula for radiation exchange between two bodies using the definition of radiosity and irradiation and its application to cases of radiation exchange between three or four bodies (e.g. boiler or other furnaces), simplification of the formula for its application to simple bodies like two parallel surfaces, concentric cylinders and a body enveloped by an other body etc.

Error in Temperature measurement by a thermocouple probe due to radiation losses.

Books

1Fundamentals of Heat and Mass transfer by DS Kumar, SK Kataria and Sons, Delhi
2. A Course in Heat and Mass Transfer by S Domkundwar; Dhanpat Rai and Sons, Delhi
3. Heat Transfer by AJ Chapman; Macmillan Publishing Company, New York
4. Heat transfer by JP Holmans, McGraw Hill, London
5. Fundamentals of Heat and Mass transfer by Frank P Incropera and David P De Witt, John Wiley and Sons

ME-313 HEAT TRANSFER LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Determination of thermal conductivity of :
- a solid insulating material by slab method
- powder materials by concentric spheres method / or by some transient heat transfer technique
- a metal by comparison with another metal by employing two bars when kept in series and / or in parallel under different boundary conditions
- Liquids by employing thin layer

2. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept:
a) along the direction of flow
b) perpendicular to the direction of flow
c) inclined at an angle to the direction of flow

3. To plot the pool boiling curves for water and to determine its critical point

4. Determination of heat transfer coefficient for
i) film condendsation
ii) drop-wise condensation

5. Determination heat transfer coefficient by radiation and hence find the Stefan Boltzman's constant using two plates/two cylinders of same size by making one of the plates/cylinders as a black body.

6. Determination of shape factor of a complex body by an analog technique.

7. To plot the temperature profile and to determine fin effectiveness and fin efficiency for
i) A rod fin when its tip surface is superimposed by different boundary condition like.
a) Insulated tip
b) Cooled tip
c) Temperature controlled tip
ii) Straight transfer fins of various sizes and optimization of fin proportions
iii) Circumferential fins of rectangular/triangular section

8. evaluate the performance of a heat pipe
9. Fluidised bed heat transfer

ME-305 AUTOMOBILE ENGINEERING

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Detailed Contents

1. Introduction

Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit.

2. Power Unit

Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system.

3. Fuel Supply System

Air cleaner and fuel pumps; Air fuel requirements and carburation; Modifications in a simple carburettor to meet different starting, running, idling and accelerating consitions; constructional details of carburetors and fuel injection systems used in Indian make vehicles. Diesel fuel system - cleaning, injection pump, injector and nozzles.

4. Lubrication and Cooling Systems

Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution.

Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

5. Chassis and Suspension

Loads on the frame, considerations of strength and stiffness, engine mounting, conventional and independent suspension systems; shock absorbs and stablizers; wheels and tyres.

6. Transmission system

Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission

7. Steering System

Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering.

8. Braking System

General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances

9. Electric System

Conventional (coil and magneto) and transistorized ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements : voltage and current regulation

10. Maintenance

Preventive maintenance, trouble shooting and rectification in different systems; engine turning and servicing

Books

1. Automotive mechanics by Crouse WH; McGraw Hill Publishing Co
2. Automotive Mechanics by Heitner J; East West Press
3. Automobile Engineering Vol I and II by Kirpal Singh, Standard Publishers

ME-315 AUTOMOBILE ENGINEERING LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments

1. Valve refacing and valve seat grinding and checking for leakage of valves
2. Trouble shooting in cooling system of an automotive vehicle
3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap
4. Demonstration of sterring system and measurement of steering geometry angles and their impact on vehicle performance.
5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. Replacing of ring and studying the method of replacing piston after repair.

ME-307 MECHANCIAL MEASUREMENT AND METROLOGY

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Detailed Contents

1. General Concepts
Need and classification of measurements and instruments; basic and auxiliary functional elements of a measurement system; Mechanical versus electrical / electronic instruments; primary, secondary and working standards.
2. Static and Dynamic Characteristics of Instruments
Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone.
Zero, first and second order systems and their response to step, ramp and sinusoidal input signals.
3. Errors in Measurement
Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, ejection of test data; curve fitting, error propagation; Design and planning of experiments and report writing.
4. Metrology
Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; comparators - their types, relative merits and limitations; Angular measurements - sine bar, clinometer, angle guage; concept and measurement of straightness and flatness by interferometry; surface roughness - specifications and measurement by Talysurf, Measurement of major

diameter, minor diameter, effective diameter, pitch, angle and form of threads for internal and external threads; measurement of tooth thickness, pitch and checking of profile for spur gears.

5. Functional Elements

Review of electro-mechanical sensors and transducers - variable resistance, inductance and capacitive pick ups, photo cells and piezo-electric transducers and application of these elements for measurement of position / displacement, speed / velocity / acceleration, force and liquid level. Resistance strain guages, guage factor, bonded and unbonded guages, surface preparation and bonding technique signal conditioning and bridge circuits, temperature compensation, application of strain guages for direct, bending and torsional loads. Introduction to amplifying, transmitting and terminating devices.

6. Pressure and Flow Measurement

Bourdon tube, diaphragm and bellows, vacuum measurement - Mcleod guage, thermal conductivity guage and ionisation guage; Dead weight guage tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: flow visualisation techniques.

7. Temperature Measurement

Thermal expansion methods - bimetallic thermometers, liquid-in-glass thermeter and filled-in-system thermometers; thermo-electric sensors - common thermo couples, reference junction considerations, special materials and configurations; metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

8. Speed, Force, Torque and Shaft Power Measurement

Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters.

Books

1. Measurement System : Application and Design by Doebelin E.O; McGraw Hill Publishing Company.
2. Experimental Methods for Engineers by Holman JP; McGraw Hill Publication Company.
3. Mechanical Measurement and Control by Kumar DS; Metropolitan Book Co Pvt. Ltd., New Delhi.
4. Engineering Metrology by Jain RK
5. Automatic Control systems by Kuo BC; Prentice Hall

ME-317 MECHANICAL MEASUREMENT AND METROLOGY LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Measurement with the help of vernier caliper and micrometer
2. Measurement of an angle with the help of sine bar
3. Measurement of surface roughness
4. Measurement of gear elements using profile projector
5. Three wire method to determine effective diameter of external threads
6. Measurement of thread element by Tool makers microscope
7. Calibration of a pressure guage with the help of a dead weight guage tester
8. Use of stroboscope for measurement of speed of shaft
9. Use of pilot tube to plot velocity profile of a fluid through a circular duct
10. Preparation of a thermocouple, its calibration and application for temperature measurement

ME-309 Numerical Methods in Engineering

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Errors in Numerical Calculations
Errors and their analysis, general error formula, errors in a series approximation

2. Solution of algebraic and Transcendental equations: Bisection method, iteration method, Method of false position,, Newton -Raphson method, solution of systems of non linear equations, method of iteration and

3. Interpolation method:
Errors in polynomial interpretation, finite difference , forward, backward and central difference, Difference of a polynomial, Newtons formulae for interpolation, central difference intepolation formulae, Interpolation with unevenly spaced points, Newton's general interpolation formula, interpolation by iteration
4. Curve Fitting:
Cubic splines and approximation:introduction, Least square curve fitting,,Procedures -fitting a straight line, non linear curve fitting, curve fitting by a sum of exponentials, Data fitting with cubic splines-derivation of governing equation, end conditions
5.Numericl Differentiation and Integration
Numerical differentiation- cubic spline method: maximum and minimum values of a tabulated function; Numerical Integration- trapezoidal rule, Simpson1/3 rule, Simpsons 3/8 rule, Newton-cots integration formulae; Euler-Meclaurin formula, Gaussian integration(One dimensional only)
6.Matrices and Linear systems of equations
Introduction, Inverse of Matrix, Solution of linear systems, Matrix inversion method, Gaussian Elimination method(fall and banded symmetric and unsymmetric systems), Eigen value problems

7. Numerical solution of ordinary differential equations:
Solution by Taylor's series, Prediction -correction method, Boundary value problems, Prediction corrector method, Euler's and modified Euler's method, Runge-Kutta method, finite difference methods

8. Numerical solution of Partial differential equations
Finite difference approximation to derivatives, Solution to Laplaces equation- Jacobi's method, Gauss -Siedel method, S.O.R method, Parabolic equation and their solution using iterative methods

Books:
1. Computer Oriented Numerical Methods- V. RajaRaman
2. Numerical Methods in Fortran -Mc Cromik and Salavadory
3. Elementary Numerical Analysis, S.D. Conte, & Cari De Boor. Mc Graw Hill.
4.Applied Numerical Methods, Cornahn B., Et al, John Wiley.

ME-319 Numerical Methods in Engg. (Lab)

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. To develop computer program to determine roots of a given equation using method of
 a. False position
 b. Newton -Raphson method,
2. To develop computer programs for solution of system of simultaneous linear equations using:
a. Gauss Elimination Technique, without and with specified boundary conditions, for full as well as bounded symmetric and unsymmetrical matrices
b. Gauss Shield iterative technique Successive over Relaxation(S.O.R) Technique

3. Linear and Non-Linear curve fitting technique

4. Numerical Integration with Simpson's rule and Gaussian Integration

5. Solution of ordinary differential equations by (i) Eular Method (ii) Runge-Kutta Method (iii) Taylor Series Methods

6. Solution of partial differential equations using S.O.R. Technique with special reference to heat conclusion equation.

ME-321 Computer Aided Drafting Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Learn the basic initial setting and viewing of the drafting software's interface.

2. Learn the basic options of drawing aids like grid, snap, ortho etc. and other aids for distance and mass properties calculations

3. Learn and draw the basic entities in 2D

4. Learn and use the various modify commands of the drafting software

5. Learn and use the layers and blocks in drafting software

6. Use hatching and dimensioning to detail out a component drawings

7. Understand different coordinate system and do a exercise on drafting software using this

8. Draw the different types of 3D modeling entities using viewing commands to view them

9. Draw the different Surface model with different editing commands

10. Learn and use shading and rendering techniques for better visual appearance
11. Use and learn import/export techniques and customization of drafting software

ME-302 MACHINE DESIGN-II

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100
Examination Hrs.: 04

Course Objective :

1. Understand the selection/ Design of each of the transmission components
    a) Flat, V-Belt and rope drive
    b) Chain drives
    c) Gear drives of different types
    d) Selection of sliding and rolling bearings and their housing
    e) Flywheel and pulley
    f) Closed coiled, helical and leaf springs
    g) Various types of clutches and brakes
    h) Lubrication in the transmission systems
2. To learn the design or design modification for manufacturing and assembly
3. To understand the basic concept of computer aided design i.e.
    a) The basic Theory of CAD Techniques
    b) Design stragergies of different CAD/Softwares
    c) Functioning/ Structure of CAD Softwares
4. To handle live projects of transmission systems efficiently

Detailed Contents

1. Design of Flat belt, V-belt and rope (steel wire), Design of the pulley for the same
2. Selection of Chain Drive
3. Design of spur, helical, straight bevel gears, worm and worm wheel
4. Bearing Selection, Design of sliding and rolling type of bearings, Detailed of bearing housing
5. Design of Flywheel for different operation
6. Design of Close-coil, Helical and Leaf springs
7. Design of Contact clutches i.e. Plate and cone types, Band, Block, Band and block brakes
8. Design of Lubrication in transmission system
9. Computers in Design: Basic Theory of CAD Software, structure of CAD software, Design Philosophy, Structure of CAD Softwares, Designing a CAD Software

BOOKS

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinal, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Sharma, Aggarwal, Kataria Publishers
6. Machine Design by Goyal and Bahl, Standard Publishers
7. Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore
8. Machine Design Data Book by V.K.Jadon (IK International Publications)

Note: Design data book by " design Data Book compiled by PSG Coimbatore

Or

Machine Design Data Book by V.K.Jadon (IK International Publications) is allowed to be used in the examination."

ME-310 MACHINE DESIGN -II PRACTICE

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Review of principles of retainment, alignment and assembly, of various components of machines, various types of oil seals: friction lock and its applications in reciprocating cam-followers, assembly and link motions.

2. Study the layout of some existing transmission system design and suggest a new conceptual design by removing the shortcomings of the existing design

3. Find an assembly containing the belt and pulley mechanism and do the complete design calculations and then justify the existing design.

4. Calculation of the velocity ratios required in a gear box and then design the gearbox in practical application (gearbox application must involve different types of gears like bevel, spur and helical gears)

5. Find a transmission system involving the worm an worm wheel and then find out the inputs required for its design and justify the design.

6. The gearbox design in the exp no. 5, Design the shafts required to support the assembly and design it for manufacturing and assembly.(with actual calculations of the loads and the end conditions)

7. For a press of your machine shop, study the process and suggest the design parameters of the flywheel required. Justify the design if flywheel is already there.

8. Design springs for practical application for the given conditions and constraints and find its practical availability.

9. Select a mechanical component or system, convert its design procedure into an algorithm and write a code for its design or with the help of an application software.

ME-304 REFRIGERATION AND AIRCONDITIONING

Internal Marks: 40 **L T P**
External Marks: 60 **4 1 0**
Total Marks: 100

Detailed Contents

1. **Basic Concept**
Natural and Mechanical refrigeration; Application of Refrigeration; Units of refrigeration and Coefficient of performance; Refrigeration effect, cooling capacity and COP of a refrigerator; heating effect, heating capacity and COP as heat pump; Reversed Carnot cycle and its limitations

2**. Bell Coleman Cycle and Aircraft Refrigeration**
Bell Coleman Cycle and its analysis; optimum COP and pressure ratio, necessity of air craft refrigeration - air cycle refrigeration systems and their comparison

3. **Vapour Compression Refrigeration Cycle**
Vapour compression cycle on P-V, P-H and T-S diagrams;
Deviation of actual cycle from theoretical cycle; Compressor capacity and volumetric efficiency, Analysis of theoretical and actual vapour compression cycles; Effect of suction pressure, discharge pressure, subcooling, super heating and pressure drop in valves on performance and cooling capacity.

4. **Vapour Compression Refrigeration with Multiple Evaporators and Compressors**
Compound compression with single and multiple expansion valves, water intercooling and flash intercooling; multiple load systems with single and multiple expansion valves

5. **Vapour Absorption Refrigeration Cycle (No Mathematical Analysis)**
Principle of absorption system; components of the system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia absorption refrigeration system; Lithium Bromide - water absorption system; Theory of mixtures; temerature concentration and enthalpy concentration diagrams; comparison between absorption and compression systems; Electrolux refrigeration system.

6. **Refrigerants**
Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; Effect of moisture and oil miscibility; Refrigerants dying agents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Ecofriendly refrigerants and action plan to reduce ecological hazards.

7. **Non-Conventional Refrigeration Systems (No Mathematical Analysis)**
Steam Jet Refrigeration; Cascade Refrigeration System; Mixed Refrigeration Systems; Vortex Tube Refrigeration, Thermoelectric cooling; Linde and Claude cycles, cryogenics and its engineering applications.

8. **Air Conditioning Concept and Applications;**
Psychometric properties of air; Dry bulb, wet bulb and dew point temperatures; Relative and specific humidity; degree of saturation adiabatic saturation temperature, enthalpy of air and water vapours; psychometric chart. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning.

9. **Psychometric Processes**
Sensible heating and cooling, cooling with dehumidification; Heating with dehumidification; by-pass factor; chemical dehumidification; adiabatic mixing, air washer.

10. **Calculations for Air –conditioning Load and for Rate and state of Supply Air**
Sources of heat load; sensible and latent heat load; sensible heat factor; appratus

dew point temperature; Rate and state of supply - air for air- conditioning of different types of premises.

11. **Refrigeration and Air Conditioning Equipment**

Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

BOOKS

1. Refrigeration and Conditioning by CP Arora, Tata McGraw Hill
2. Refrigeration and Conditioning by Manohar Prasad, Wiley Eastern Limited
3. Refrigeration and Conditioning by Jordan and Priester, Prentice Hall of India
4. Refrigeration and Conditioning by WF Stoecker, McGraw

ME-312 REFRIGERATION AND AIRCONDITIONING LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus
2. Study and performance of domestic refrigerator,
3. Study the performance of and Eectrolux refrigerator
4. Study of an Ice plant and visit to a cod storage for study
5. Calculation/ Estimation of cooling load for large building
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Study and performance of window type room air conditioner

ME-306 FLUID MACHINERY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Detailed Contents

1. General Concepts

Impulse momentum principle; jet impingement on stationary and moving flat plates, and on stationary or moving vanes with jet striking at the centre and tangentially at one end of the vane; calculations for force exerted, work done and efficiency of jet. Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid and the type of fluid etc. Euler's equation for energy transfer in a turbomachine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes.

2. Pelton Turbine

Component parts and operation; velocity triangles for different runners, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions

3. Francis and Kaplan Turbines

Component parts and operation velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes - its function and types. Function and brief description of commonly used surge tanks.

4. Centrifugal Pumps

Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump - suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery; Priming and priming devices, Multistage pumps - series and parallel arrangement; submersible pumps. Construction and operation; Axial and mixed flow pumps; Trouble shooting - field problems, causes and remedies.

5. Similarity Relations and Performance Characteristics

Unit quantities, specific speed and model relationships, scale effect; cavitation and Thoma's cavitation number; Concept of Net Positive Suction Head (NPSH) and its application in determining turbine / pump setting

6. Reciprocating Pumps :-- Components parts and working; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels

7. Hydraulic Devices and Systems

Const., operation and utility of simple and differential accumulator, intensifier, fluid coupling and torque converter, Air lift and jet pumps; gear, vane and piston pumps.

BOOKS

1. Hydraulic Turbines by Daughaty RL; McGraw Hill Book Co.
2. Hydraulic Machines by Jagdish Lal; Metropolitan Book Co Pvt. Ltd.
3. Fluid Mechanics and Fluid Power Engineering by Kumar DS; SK Kataria and Sons, Delhi

ME-314 FLUID MACHINERY LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Determination of various efficiencies of Hydraulic Ram
2. To draw characteristics of Francis turbine
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
4. To draw the characteristics of Pelton Turbine
5. To draw the various characteristics of Centrifugal pump
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan

PE-408 INDUSTRIAL AUTOMATION AND ROBOTICS

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

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 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-414 INDUSTRIAL AUTOMATION AND ROBOTICS LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

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

CE-216 ENVIRONMENTAL SCIENCE

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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 loass, 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 rahabilitation 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 (Preventation 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)

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

¨ Optimum utilization of resources

¨ 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

8th Semester

ME-402 INDUSTRIAL SAFETY and ENVIOREMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Course Objectives:

1. Understand importance of safety at work
2. Apply ergonomics to safety
3. Analyze industrial hazards
4. Understand various safety measures and how it leads to increasing plant productivity.
5. Understand basics of environmental design
6 Compute heat load requirements of industrial buildings.
7. Understand various methods of solar architecture.
8. Compare the above with conventional methods
9. Understand various industrial wastes and their methods of treatment.
10. Understand ergonomics and its importance in system design.

Detailed Contents

1. Meaning & 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, Hazard identification techniques, Accident investigation, reporting and analysis.
2. Planning for safety: Definition, purpose, nature, scope and procedure. Range of planning, variety of plans. Policy formulation and implementation of safety policies.
3. Safety measures in a manufacturing organization, safety and economics, safety and productivity. Employees participation in safety. Safety standards and legislation
4. Meaning of environment and need for environmental control. f 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 environment design for improved efficiency and accuracy at work.
5. 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 heat exposures: control at source, insulation, and local exhaust ventilation. Control of radiant heat, dilution ventilation. Local relief.
6. Industrial Lighting: Purpose of lighting, benefits of good illumination. Phenomenon of lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Maintenance standards relating to lighting and colour.
7. Noise & 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.
8. Environment Standards: Introduction to ISO 14000; Environment standards for representative industries.

BOOKS:

1. Ventilation by Joselin, Edward Arnold
2. Noise Reduction by Beranek, Mcgraw Hill
3. Modern Safety and health Technology by DC Reamer; R. Wiley
4. Industrial Accident Prevention by Heinrich, HW; McGraw Hill
5. The process of Hazard Control by Firenze, RJ; Kendale

ME-404 CAD/CAM

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

1. Understand the applications and benefits of CAD
2. Understand the various computer hardware devices
3. Understand the various software used in CAD and the functions of a graphics package.
4. Understand geometric transformation.
5. Understand various representations of curves and surfaces.
6. Understand the various concepts and characteristics in geometric modeling.
7. Understand various data exchange formats.
8. Apply CAD techniques to finite element mesh generation.
9. Understand the basic concepts of CAM
10. Analyze the components and systems of NC and CNC machine tools.
11. Understand and apply various programming methods for specific jobs.
12. Understand the concepts of DNC and adaptive control
13. Understand the fundamentals and advantages of group technology.
14. Classify various CAPP systems.
15. Understand FMS and CIMS with reference to components, advantages and applications.

Detailed Contents:

Course contents

1. Fundamentals of CAD: Introduction: Design Process: Application of computers in design: Creating manufacturing database: benefits of CAD.

2. Computer Hardware; Graphic input devices; display devices; Graphics output devices; Central processing unit (CPU)

3. CAD software and Database: Software configuration of a graphics system: functions of a graphics package: geometric modeling: Database structure and control; Graphics standard: GKS and IGES.

4. Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.

5. Representation of curves and surfaces: Polygon, meshed and ruled surfaces: Bezier curves; B-spline curves.

6. Geometric Modeling: Wireframe model: solid modeling: representation, volumetric properties, surface modeling, concepts of hidden-line removal and shading: Kinematics analysis and simulation.

7. Application of CAD techniques to finite Element Mesh Generation.

Computer Aided Manufacturing (CAM)

8. Introduction: Basic concepts of manufacturing system and CAD/CAM.

9. NC/CMNC Machine Tools; NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

10. Group Technology (GT): Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

11. Computer Aided Process Planning: Introduction and benefits of CAPP. Types of CAPP systems, machinability data selection systems in CAPP.

12. Flexible Manufacturing System (FMS) and Computer integrated manufacturing system: FMS and its advantages, components of a FMS system. Introduction to CIMS.

BOOKS:

1. CAD/CAM by Groover & Simmers, Prentice Hall of India
2. Automation, Production Systems and computer integrated manufacturing by Groover, Prentice Hall of India
3. Computer Integrated Design and Manufacturing by D.D. Bedworth, M.R Henderson & P.M. Wolfe, Tata MCGraw Hill Pub. Co.
4. CAD/CAM - theory and Practice by Zeid Ibraham, Tata McGraw Hill Pub Co.

ME-410 CAD/CAM Laboratory

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments:

1) CAD exercises using Auto Cad software

2) Part-programming on CNC machines

3) Execution of part programme for machining given profile.

4) Programming of robots for various applications.

5) Part modeling using some of the modeling technique

6) Component assembly in CAD and generating and modifying drawings

ME-406 OPERATIONS RESEARCH

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Detailed Contents

1. Introduction : Origin of OR and its role in solving industrial problems : General approach for solving OR problems. Classification of mathematical models : various decision making environments.
2. Deterministic Models : Formulation of deterministic linear mathematical models : Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis : transportation, assignment and sequencing models; Introduction to goal programming; Solution techniques of linear goal programming problems.
3. Probabilistic Models : Decision making under uncertainty : Maximum and minimum models; Introduction to decision tree. Game theory : Solution of simple two person zero-sum games :Examples of simple competitive situation.
4. Simulation: Concept general approach and application. Use of Monte-Carlo simulation technique to queuing and inventory problems.
5. Dynamic Programming: Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems.
6. Queuing theory: Types of queuing situation : Queuing models with Poisson's input and exponential service, their application to simple situations.
7. Replacement Models : Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.
8. Inventory models : Classification of inventory control models : Inventory models with deterministic demand, inventory models with probabilistic demand, inventory models with price breaks.
9. Network models : Shortest route and traveling sales - man problems, PERT & CPM introduction, analysis of time bound project situations, construction of net works, identification of critical path, slack and float, crashing of network for cost reduction, resource leveling and smoothening.

BOOKS:

1. Principles of Operations Research HM Wagner, Prentice Hall.
2. Operations Research PK Gupta and DS Hira, S. Chand & Co.
3. Introduction to Operation Research Taha
4. Introduction to Operation Research F.S. Hiller and G.I. Libermann, Holden Ray.

ME-408 MECHANICAL VIBRATIONS

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Detailed contents

1. Introduction ; Basic concepts, Methods of vibration analysis, Types of vibration, Periodic &Harmonic vibrations .
2. undamped free vibrations, damped free vibrations and damped force vibrations of single degree of freedom system,vibration isolation transmissibility.vibration measuring instruments.
3.Two degrees of Freedom systems:

   a) principal modes of vibrations, natural frequencies, amplitude ratio, forced harmonic vibration .combined rectilinear & angular modes.

   b) Application; Vibration absorber - principle, centrifugal pendulum vibration absorber, torsional vibration damper, untuned viscous damper, dry friction dampers, torsional vibration of two rotor systems.

4

   a) Multi-degree of freedom systems: undamped free vibrations, influence coefficients,generalised coordinates,orthogonality principal,matrix alteration methods,: Rayleigh and Dunkerley, Holzer's , stodola method,Eigen values & eigen vector

   b) continuous systems: Vibration of a string, longitudinal vibrations of bars, Euler's equation of motion for beam vibration, natural frequencies for various end conditions, torsional vibration of circular shafts

Books:

1. Mechanical Vibrations by GK Grover, Hem chand and Bros, Roorkee

2. Mechancial Vibrations by KK Purjara, Dhanpat Rai and Sons, Delhi

3. Mechanical Vibrations by V.P.Singh,.

ME-412 MECHANCIAL VIBRATION LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Determine the viscosity of given fluid by single wire torsional pendulum.
2. Determine the natural frequencies of a coupled pendulum.
3. Find out the fundamental natural frequency of a cantilever beam
4. Determine the modulas of elasticity from free vibration test
5. Study of forced vibration of a two degree of freedom system under harmonic excitation
6. Study of a dynamic absorber

7.determine coefficient of dry friction from measurement of natural frequency of vibration of a bar resting on two disks rotating in opposite direction

Detailed Syllabus:

Group-I

DE/ME-1.1 I. C. Engines

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction to IC Engines: Definition of engine; Heat Engine, Historical Development of IC Engines, Classification & Nomenclature, Application of IC Engines, Air Standard Cycle, Carnot Cycle, Sterling Cycle, Ericson Cycle, Otto Cycle, Diesel cycle, Dual Cycle, Thermodynamics Analysis of these cycles.

Actual Working of I.C. Engine: Working of 4 stroke petrol & diesel engines and their valve timing diagram, working of 2-stroke petrol & diesel engines & their valve timing diagrams, comparison of two stroke & four stroke engines, Actual working of 2 & 4 stroke gas engine and their valve diagram. Fuel Air Cycles and their analysis: Introduction to fuel air cycles and their significance, composition of cylinder gases, variable specific heats, Dissociation, effect of no. of moles, comparison of air standards & fuel air cycles, effect of operating variable like compression ratio, fuel air ratio, actual cycles and their analysis; Difference between Actual and Fuel-Air Cycle, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

IC Engine Fuels: Introduction, types of fuels, solid, liquid and gaseous fuels, chemical structure of petroleum, petroleum refining process, important qualities of S.I. & C.I. Engine fuels and their rating. Combustion of fuels; Calorific valves of fuels, theoretical determination of CV of fuel, combustion equation for hydrocarbon fuels, determination of minimum air required for combustion, conversions of volumetric analysis of mass analysis, Determination of air supplied from volumetric analysis of Dry flue gases, Determination of excess air supplied , Determination of % of carbon in fuel burning to CO & CO_2 , Determination of minimum quantity of air supplied to gaseous

Fuel Supply System: Fuel Supply System and fuel pumps, properties of air fuel mixture, a sample carburetor an its working, approximate analysis of simple carburetor, Actual air fuel ratio of single jet carburetor, Exact analysis of single jet carburetor, ideal requirements from a carburetor, limitations of single jet carburetor, different devices used to meet the requirements of an ideal carburetor. Different modern carburetors, introduction to petrol injection, fuel injection systems for C.I. Engines: classification of injection systems, injection pump, injection pump governor, mechanical governor, fuel injection systems, injection pump Governor, Mechanical Governor, Fuel Injector, Nozzle, Injection of S.I. Engines, Fuel Filters.

Combustion in S.I. Engines: Introduction, Stages of Combination in S.I. Engine, Flame font propagation, factor influencing the flame speed, ignition lag and factors affecting the lag, Abnormal combustion and knocking, control and measurement of knock, rating of S.I. Engine fuels and anti knock agents, combustion chambers of S.I. Engines

Supercharging: Introduction, purpose of supercharging, type of superchargers, analysis of superchargers, performance of superchargers, Arrangement of Supercharger and its installation, Turbo charged engines, supercharging of S.I. & C.I.

Engines. Limitations of supercharging.

Measurement and Testing: Measurement of friction horse power, brake horse power, indicated horse power, measurement of speed, air consumption, fuel consumption, heat carried by cooling water, heat carried by the exhaust gases, heat balance sheet, governing of I.C. Engines, performance characteristics of I.C. Engines: Performance parameters, performance of S.I. Engines, performance of C.I. Engine, Engine performance maps

Books:

8. Internal Combustion Engines by V. Ganesan, Prentice Hall of India
9. A Course in Internal Combustion Engines by Damundwar by Dhanpath Rai & Sons

DE/ME-1.2CRYOGENIC TECHNOLOGY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

PART - I
Hours Topic
1. History of cryogenic engineering; application of cryogenics
2. Properties of Oxygen, Nitrogen and Argon, and Hydrogen, Helium and rare gases
3. Thermal, mechanical and electrical properties of engineering materials at low temperature: 167 Introduction to the phenomenon of superconductivity and its applications

PART - II
3. Thermodynamics of ideal liquefaction cycles; Joule-Thomson effect 3 Linde cycle; prncooled linde cycle; exercise
4. Claude, Heylandt, and kapitza cycles; exercises
5. Liquification of hydrogen and helium

PART-III
Heat exchangers and definition of effectiveness
1 Coiled tube (hampson type) and brazed Aluminum heat exchangers
2 Cryogenic expansion engines and turbines

PART -V
1. Principal of binary Distillation
2. linde signal & double column system

PART -IV
3. Types of cryogenic insulation: foam, fibre, powder vacuum
1. Liquid cryogen storage vessels and cryogen transfer line;

PART -VII
2.Measurement of temperature: gas and vapour pressure Thermometers, thermocouple, RTD and semiconductor sensors;

PART -VIII
3. Safety in cryogenic systems fir, asphyxiation, cold burns and pressure problems

Books
1. Cryogenic Systems by Randall Barron
2. Cryogenci Research amd Applications Marshall Sitting and Stephen Kidd D.Van Norstad Company, Inc.USA

DE/ME-1.3 NON-CONVENTIONAL ENERGY RESOURCES

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

a) Introduction: Renewable and non-renewable energy sources, their availability and growth in India; energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements

2. Solar Energy: Solar radiation - beam and diffuse radiation; earth sun angles, attenuation and measurement of solar radiation; Optical properties of materials and selective surfaces; Principles, general description and design procedures of flat Platte and concentrating collectors; Performance analysis of cylindrical and parabolic collectors; Solar energy storage systems - their types, characteristics and capacity; solar ponds. Applications of solar energy in water, space and process heating, solar refrigeration and air conditioning; water desalination and water pumping; solar thermal power generation; solar cells and batteries; economic analysis of solar systems

3. Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of accodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations

4. Direct energy conversion systems:

i) Magnetic Hydrodynamic (MHD) Generator: gas conductivity and MHD equations; operating principle, types and working of different MHD systems – their relative merits; MHD materials and production of magnetic fields.

ii) Thermo-electric generators: Thermo-electric effects and materials; thermo-electric devices and types of thermo-electric generators; thermo-electric refrigeration.

iii) Thermionic generators: thermoionic emission and materials; working principle of thermionic convertors

iv) Fuel Cells: thermodynamic aspects; types, components and working of fuel cells.

v) Performance, applications and economic aspects of above mentioned direct energy conversions systems

5. Miscellaneous Non-Conventional energy Systems:

i) Bio-mass: Concept of bio-mass conversion, photo-synthesis and bio-gasification; Bio gas generators and plants - their types constructional features and functioning; digesters and their design; Fuel properties of bio gas and community bio gas plants

ii) Geothermal: Sources of geothermal energy - types, constructional features and associated prime movers.

iii) Tidal and wave energy: Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices Advantages/disadvantages and applications of above mentioned energy systems.

Books

1. Solar Energy : Fundamentals and Applications by H.P. Garg & Jai Prakash, Tata McGraw Hill
2. Soar Energy: Principles of Thermal Collection and Storage by SP Sukhatme, Tata McGraw Hill
3. Solar Engineering of Thermal Processes by Duffic and Beckman, John Wiley
4. Energy Conversion by Chang; Prentice Hall
5. Direct Energy Conversion by Soo; Prentice Hall
6. Fuel Cells by Bockris and Srinivasan; McGraw Hill
7. Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison

DE/ME-1.4 ENERGY CONSERVATION AND MANAGEMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Need for energy conservation, its potentials, fiscal incentives, primary energy sources such as coal, gas, oil, nuclear fuel

Optimum use of prime movers for power generation such as team turbines, gas turbines, diesel and gas engines, energy intensive industries i.e. iron and steel, aluminum, pulp and paper, textile and oil refineries and their energy usage pattern.

Plant Good house keeping measures in air conditioning boilers, combustion system, steam, furnaces and general awareness, Energy audit, methodology and analysis, Energy conservation case studies in air conditioning, boiler and burners

Waste heat recovery systems i.e. recuperates economizers waste heat boilers, heat pipe heat exchangers regenerators etc. energy storage systems thermal storage, insulation, refractory, specialized processes such as Dielectric & micro wave heating, electronic beam welding, Fluidized bed technology, laser as a welding tool, Alternative sources of energy.

Text Books

9. Industrial Energy Conservation Handbook, D.A., Oxford Press, London
2. Energy Conservation Handbook, Utility Publication Ltd., Hyderabad
3. Richard Greene, Process Energy conservation (Chemical Engineering), McGraw-Hill Publication Co., New York.

DE/ME-1.5 FLUID MECHANICS-II

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Potential Flow
Stream function and velocity potential functions for standard flow patterns uniforms flow, source/sink, doublet and free vortex ; combination of uniform flow with certain flows to obtain flow patterns of various shapes such as flow past a half body, a cylinder, a Rankine oval body, and a cylinder with circulation : Kutta joukowski Theorem-lift on a cylinder.

2. Viscous Flow
Navier Stokes equation of motion; Relationship between shear stress and pressure gradient; two dimensional laminar flow between two fixed parallel planes ; Plain Couette flow and its application to hydro-dynamic theory of lubrication.

3. Turbulence
Fluctuation velocity components; intensity and scale of turbulence; Reynolds equations and turbulence modeling.

4. Boundary Layer
Salient features of flow pattern in a boundary layer; Velocity and shear stress distribution along the boundary; Von-Karman momentum integral equation, Quantitative correlation for boundary layer thickness, local skin friction coefficient and drag coefficient in laminar, turbulent and laminar turbulent combined boundary layer flows on a flat plate without pressure gradient; flow over a courved surface boundary layer separation and its control.

5. Flow Around Immersed Bodies
Concept of friction, pressure, wave and induced drag- lift and drag coefficients; variation of drag coefficient with Reynolds number for two dimensional bodies (flat plate, circular cylinder) ; Vortex shedding from cylindrical bodies; effect of streamlining ; drag coefficient versus Reynolds number for flow past axisymmetric bodies (sphere) ; Terminal velocity ; Lift of an airfoil ; Airfoil of finite length-effect on drag and lift ; Downwash and induced drag.

6. Compressible Flow
Wave propagation and sonic velocity; Mach number, Limits of incompressibility and compressible flow regimes; pressure field due to a moving source of disturbance, Mach cone and Mach angle. Basic equations for one-dimensional compressible flow; static and stagnation values; Isentropic flow relations; compressibility correction factor. Isentropic flow through a duct of varying cross-section, mass flow rate and choking in a converging passage. Normal shock and change in flow properties across a normal shock wave.

Books

1. Mechanics of Fluids by Massey BS, ELBS and Van Nostrand Reinhold Co.
2. Fluid Mechanics by Pao HF Richard ; John Wiley and Sons.
3. Fluid Mechanics and Fluid Power Engineering by Kumar DS; SK Kataria and Sons, Delhi.
4. Fluid Mechanics by Douglas JF., Gasionckw, and Swaffield JP ; Pitman.
5. Fluid Mechanics by Streeter VL and Wylie EB : McGraw Hill International.

DE/ME-1.6 SOLAR ENERGY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Solar Flux and Weather Data :
Introduction, Solar Constant, Spectrum of sun, Diurnal Variation of Direct Sunlight, Height variation of direct sunlight. Standard Atmosphere, Zenith Distance Flux Variation, Geographical distribution of sun-shine and effects of weather on Solar Flux. Introduction to solar Flux observation, Instruments such as pyranometer, Phyrheliometer and Sunshine Recorder, Correlation between direct and total Insulation, Solar flux variation dynamic, Correlation of sunshine with Wind Velocity, Environmental Thermal Infrared Flux and ETIR Model.

Solar Availability:-
Introduction, Zenith Distance Vs time, Time of sunrise and sun-set fully Tracking collector, Variation of flux curves with latitude and geometry, Introduction tom Fixed Flat plate (horizontal, latitude Tilted, fixed latitude + 15°, Vertical South-facing, seasonally Tilted) N-S and horz, east west tracking and N-S polar east west tracking, East west horz and N-S tracking, Comparison of theoretical curves with observation, comparison of daily output; Peak flux Vs Average flux,

Heat Transfer in Solar Collectors :
Introduction, Heat Losses in a Distributed Collector system. The Liquid Transfer Module System, Solar Heat Availability, Fluid Mechanics, Fluid Properties, Temperature Rise, Solar Flux, Pressure Drop Relations, Reynolds Number, Ratio of Power Expended to Power Generated, Magnitude of Power Output/Input Ratio, Parametric Relationships for Fluid Transfer, Variation of Output/Input Ratio with Solar Flux. Air-Transfer Systems, Air Heat Transfer in Terms of Volume Rate of Flow, Typical Evaluation Situation. Alternative Forms of the Heat-Rise Equation, Effect of Changing Heat-Transfer Fluid, Heat Transfer in Evacuated Collectors,
Thermodynamic Utilization of Collected Energy, Evacuated Collectot Trade offs. Linear Absorber with Air Radiation Suppression Using Honeycombs Convection Suppression Using Honey-combs, Heat Pipes, Heat Transfer alongh Thin Sheets, Differential Thermal Expansion, Problems.

Flat-Plate Collectors:
Introduction, Basic Collector Configurations, Diurnal Temperature, Profile, Thermal Inertia U-Factor, Collector Heat Balances. Sample Calculation, Surface Temperature. Efficiency versus-Temperature Curves, General Properties of an efficiency Vs Change and Temperature, The Bare Collector; Single –Window Collector, Double Window Collector Improvement of Performance, Geometrical Suppression of Convection, Window Temperature. Effect of Selective Absorber Surface, Selective Windows Facing Selective Surface Combination of Absorber and selective windows, Comparison of Thermal Behaviour for Selective Windows, Window Absorption Non reflection Coated Window, Variation of Efficiency with Solar Flux, Evacuated, Cooling, Selective Radioactive Cooling, Cylindrical Collector Structure Flat-Plate Collector performance, Solar Ponds, Problems

Energy Storage:
Introduction, Basic System Diagram, Peaking Effect of Back up Demands, Energy Storage, Hydrostorage Chemical Batteries Flywheels Chemical Storage, Compressed Air, Biological Storage, Thermal Storage, Sensible-Heat Storage, Latent-Heat Storage, Salt Eutectics, Zoned Thermal Storage Fluid Tank, Rock Thermal Storage Tank, Thermal Storage Tank Farm, Heat Management with and

without Phase Change, Thermal inertia, Calculation of Detailed Performance, Problems.

Application of Solar Energy (History and Survey Application) Community Heating & Cooling system, Solar Water pumping, Solar gas absorption refrigeration, MEC Cooling system, Two stage evaporative cooling etc.

Direct Conversion to Electricity:
Introduction, Direct conversion by Means of Solar Ce4lls, Silicon Cells, Manufacture of Silicon Cells, Efg Ribbon Silicon Cells Polycry Stalline silicon cells, Cadmium sulfide Solar Cells, Manufacture of Cadmium Sulfide Cells Gallium Arsenide Solar Cells, Thermal Behaviors of Solar Cells Cooled Solar Cells for Concentrating System. Thermo-electric Solar Cells, Thermonic Solar Cells, Phase-Change Thermal Direct Conversion, Problems.

Books

1. An Introduction to Applied Solar Energy: Aden B.Meinel & Marjoric P.Meinel.
2. Hand Book of Solar Energy : Jan F.Kreider & Fran K, Kreith.

DE/ME-1.7 Heat Exchanger Design

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction: Classification, types and applications of heat Exchangers, Heat Exchanger Design methodology, Selection of Heat Exchangers

Single Phase Heat Exchangers: LMTD and NTU methods, Rating and sizing methods, design criteria, geometry, process parameters, pressure drops and applications

Two Phase Heat Exchangers: Types of Boiling, Boiling mechanisms, two phase flow boiling pressure drop

Condensation Mechanism, types of condensers and design procedures, Evaporators, Reboilers, Multiple effect evaporators, Design procedures, Liquid chillers, kettle, thermosyphen and forced circulation Reboilers, Augmented surface heat Exchangers, Heat transfer coefficients, pressure drops, compact heat exchangers and air coolers, plate heat exchangers and plate fine heat exchangers

Heat Pipe Heat Exchangers: Types and design procedure and applications

Installation, Operation and Maintenance: Fouling factors, type of fouling and cleaning methods

Mechanical Considerations: Codes and Standards, Mechanical design requirements and materials

Books

1. Saunders EAD, Heat Exchangers Selection Design and Construction Longman Scientific and Technical John Wiley and Sons Inc. New York
2. Kern D.Q. Process Heat Transfer International Edition Mc. Graw Hill Book Company Singapore
3. Holman J.P Heat Transfer 8th Edition Mc. Graw Hill Book Company Singapore
4. Gupta J.P Fundamentals of Heat Exchangers and Pressure Vessels Technology Hemisphere Publishing Corporation New York

DE/ME-1.8 POWER PLANT ENGINEERING

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction: Energy sources for generation of electric power, Principles types of power plants-their special features and applications, Present status and future trends.

Hydro-Electric Power Plants: Classifications, Components and their general layout, Hydroelectric survey, rainfall run-off, hydrograph, flow duration curve, mass curve, storage capacity, Site selection.

Steam Power Plant: General Introduction, Developing trends, Essential features, Site Selection, Coal-its storage, preparation, handling, feeding and burning, Ash handling, dust collection, High pressure boilers.

Diesel and Gas Turbine Power Plants: Field of use, components, Plant layout, Comparison with stream power plants, Operation of combined steam and gas power plants.

Nuclear Power Plant: Nuclear fuels, nuclear energy, Main components of nuclear power plant, Nuclear reactors-types and applications, Radiation shielding, Radioactive waste disposal, Safety aspects.

Power Plant Economics: Load curves, terms and conditions, Effect of load on power plant design, methods to meet variable load, prediction of load, cost of electric energy, Selection of types of generation and generating equipment, Performance and operating characteristics of power plants, Load division among generators and prime movers, Tariff methods of electric energy.

Non-Conventional Power Generation: Geothermal power plants, Tidal power plants, Wind power plants, Solar power plants, Electricity from city refuge.

Direct Energy Conversion Systems: Thermoelectric conversion system, Thermionic conversion system, Photo voltaic power system, Fuel Cells, Magneto-hydrodynamic system.

Text Books

P.K.Nag, Plant Engineering, Tata McGraw Hill, New Delhi
Nagpal, Power Plant Engineering,Khanna Publishers, New Delhi
Arora, Domkundwar, Power Plant Engineering, Dhanpat Rai * Sons, New Delhi

DE/ME-1.9 GAS DYNAMICS

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Basic concepts of Gas Dynamics and Gas Properties:
Definition: Units and dimensions. The concepts of continuous, properties of the continuum. Methods of describing fluid motion, Lagrangian method. Eulerian Method. The integral form of the equations of Conservations of Mass. Momentum and energy as applied to Control Volumes, applications to the study flow of inviscid compressible fluids.

b) Fundamentals Equations Study of One Dimensional Flow :
Continuity equation, the momentum equation, the dynamic equation and Euller's equation. Bernoulli's equation, thrust function, steady flow energy equation.

c) Isentropic Flow:
Introduction, Acoustic velocity, Mach number, Mach line and Mach angle. Classification of flows, Karman's rules supersonic flow, flow parameters, Critical conditions stagnation values.

d) Flow in Ducts with Heating or Cooling:
Stagnation temp. change, governing equations, Rayleigh lines, choking effects in simple to change. Maximum heat transfer.

e) Flow in constant- Area Ducts with friction:
Friction loss, the friction parameter, Fannolines, effect of the increase of inlet Mach number and duct length. Chocking due to friction.
Isothermal flow through long ducts.

f) Normal Shock Waves:
Formation of shock waves, weak waves, compression waves. Governing relations of the Normal shock, Pressure. Temperature, Density, Mach number across shock.

g) Oblique shocks: Oblique shock equations, shock geometry, shock polars.

h) Flow through Nozzles:
The Converging diverging nozzle, area ratio for complete expansion, effect of varying back pressure on nozzle flow. Under-expansion and over-expansion in nozzle flow. Losses in nozzle.

i) Flow through Diffusers:
Classification of diffusers, internal compression subsonic diffuser, velocity gradient, effect of friction and area change, the conical internal-compression subsonic diffuser, external compression subsonic diffuser, supersonic diffuser, normal shock supersonic diffuser, the converging diverging supersonic diffuser.

j) Introduction to Multidimensional Flow:
The equation of continuity, the momentum equations, Bernoulli,s equation, the energy equation, Navier-Stock' Equations, Potential Flow.

Books

i. Thermodynamics of Compressible Fluid flow by Shaprio.
ii. Computational Gas Dynamics by Culbert B. Laney, Cambridge University Press

Group-II

DE/PE-2.0 Non Traditional Machining Processes

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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-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:

T**hermal 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. Electon-Beam Machining-, Generation and control of electon beam, process capabilities and limitations

Hybrid Machining Processes: concept, classification, application, Advantages

Books:

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

DE/PE-2.1 INDUSTRIAL ENGINEERING

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction: Definition and scope of industrial engineering Role of an industrial engineering Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer.

2. Plant Layout and Material Handling: Different types of layouts viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout. Types of material handling equipment, relationship of material handling with plant layouts.

3. Work-study: Areas of application of work study in industry; Method study and work measurements and their inter-relationship. Reaction of management and labour to work study; Role of work study in improving plant productivity and safety.

4. Method Study : Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques, Micromotion and macro-motion study: Principles of motion economy, Normal work areas and work place design.

5. Work Measurement : Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time.

6. Value Engineering : Types of values, concept of value engineering, phases of value engineering studies, application of value engineering.

7. Work design : Concepts of job enlargement, job enrichment and job rotation. Effective job design considering technological and behavior factors.

8. Ergonomics : Introduction to ergonomic considerations 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 Engineering & Management by Hicks, Tata McGraw Hill, New Delhi
3. Product Design and Development by Ulrich, Tata McGraw Hill, N. Delhi
4. Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers.
5. Motion and time study by R. Bernes, John-Wiley & Sons
6. Ergonomics at work, by D.J. Oborne, John Wiley & Sons.
6. Techniques of Value Analysis and Engineering by Miles, McGraw Hill.

DE/PE-2.2 MODELING AND SIMULATION

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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

Production and Operations Management
Principle of analytical modeling, kinds of analytical methods, measures of effectiveness, cost analysis 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

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

DE/ME-2.3 OPERATIONS MANAGEMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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:

10. Production and Operation Management by Charry Tata-McGraw Hill
11. Production/Operation Management by J.G. Monks Tata-McGraw Hill
12. Management of systems by R.N. Nauhria and Rajnish Prakash, Wheeler Publishing, New Delhi
13. Modern Production Management by Elwood Buffa
14. Statistical Quality Control by E. L. Grant and R.S. LeavenWorth McGraw Hill

DE/ME-2.4 NON-DESTRUCTIVE TESTING

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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-2.5 TOTAL QUALITY MANAGEMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Quality and Total Quality Management; Excellence im 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.

5.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-2.6 MAINTENANCE AND RELIABILITY ENGINEERING

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

7. 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
8. 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.
15.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. Sinha S.k.Wiley EAstern.
7. Reliability Engg., Lewis, John Wiley.

DE/ME-2.7 MATERIAL MANAGEMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

16. 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

9. 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-2.8 MANAGEMENT INFORMATION SYSTEM

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

10. Information and Decision Making: Concept of information; data versus information, characteristics of information, classification of information, cost and value of information, Use of information in the decision making process, information requirements for decision making, types of decisions, decision making process, decision making models role of information system, decision support systems, expert systems.

2. Management Information Systems (MIS) Concept, Characteristics and importance of management information systems, types of information systems role of computers in management information systems, hierarchy of data processing systems, operating elements of MIS, information needs of MIS, storage and retrieval of data processing, functions of information systems, management reports. Analysis and design cycle for MIS. Various approaches to system analysis and design. Strategic and project Planning for MIS, analysis and design, matching mission, objectives and plans of MIS with business plans, project planning for MIS, Conceptual system design, Detailed system design, Implementation, Evaluation and Maintenance of MIS.

11. Computer Networks and Data Communication Computer network : Local Area networks; characteristics topologies network structures, switching networks, OSI standards for multi vendor network. I.A.N standards, application of networks, Data Communication concepts, types and modes of transmission, hardware requirements, communication controllers, Data Communication software, data communication protocol

4. Data Base Management Systems: Introduction, data base designing, relational data base management system. Introduction to computerized data base management system.

Books

1. Information systems for Modern Management by Mudrick, Ross and Clagget Prentice Hall.
2. Management Information systems by Davis and Olson McGraw Hill
3. Information systems for management by Lucas McGraw Hill

DE/ME-2.9 ENTREPRENEURSHIP

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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 for ecasting, 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.

Group-III

DE/PE-3.0 PRODUCT DESIGN & DEVLOPMENT

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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 DETALING:
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 19811.Indistrial Design-Mayall
3. Engineering Design- Svensson.
4,. Engineering Design-Matousek
5. Mccormick K.J. (Ed) “Human Factor Engineering ” 4th edition McGraw Hill Book Company Ltd. USA 1992

DE/PE-3.1 MACHINE TOOL DESIGN

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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

DE/ME-3.3 TOOL DESIGN

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1.Process Planning:
Product Engineering, Process Engineering, Definition of Process Planning, Contents of Process Plan, Process Operations, Steps of Process Planning, Process Planning Sheet, Planning and Tooling for Low Cost Planning.
2.Jigs & Fixture
Principles of jig and fixture design, Principle of degrees of freedoms, methods of locations and clamping, Various devices for location and clamping, indexing devices, Hydraulic and pneumatic actuation of clamping devices, jig bushes, use of standard parts of jig design, type of drilling jigs, milling fixtures, lathe fixture, grinding fixtures and their classification.
3.Die Design
Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts.
4.Tool Layout for Turrets
Characteristics of Turret lathes. Differences between capstan and turret lathes, methods of holding jobs on the Turret lathe. Universal chucking equipment, universal bar equipment, operation sheet and tool layout.
5.Tool Layout for Automatics
Classification of Automatics; Turret type automatic, tool layout procedure, time required for each operation, operation sheet, tool layout, cam layout.
6.Tooling Costs
Estimating cost of a product, estimating costs of tools, Economics of tooling, Break even point analysis, minimum cost analysis.
7.Gauges
Limits and fits, Plain Gauges, types of Gauges, fundamentals of Gauge Design, Gauge makers tolerance, allowance for wear, Practical application of Taylor's principles of limit gauging, care of Gauges, Limitation of Limit Gauging.
8.Surface Finish
Elements of surface finish, Factors affecting surface finish, Effect of surface quality on Functional properties of machine parts, Evaluation of surface finish, Indian Standards on surface finish. Measurement of surface finish, Relationship of surface finish to the production methods. Finishing operations like honing, lapping, buffing super finishing etc.
Books Suggested:

1. Cole: Tool Design
2. Donaldson: Tool Design
3. ASTEM: Fundamentals of Tool Design
4. P.C.Sharma: A Textbook of Production Engg., S.Chand Publication,N.Delhi

DE/PE-3.2 NETWORK ANALYSIS

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

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.
Analysing 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/ME-3.4 FINITE ELEMENT METHOD

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Introduction:
General description of the method summary of the analysis procedure

2. Discretisation of the domain:
Type of elements, location of nodes, number of elements, simplification on offered by physical configuration of body, node numbering scheme.

iii. One & Two Dimensional Problems: Introduction, coordinates and shape functions, Potential energy approach, Galerkin Approach, Assembly of the global stiffness matrix and load vector , FEM equations and treatment of boundary conditions, quadratic shape functions, Two dimensional problems using constant strain triangles

4 Axisymmetric solids subjected to axisymmetric loadings: Axisymmetric formulation, FEM using triangular element, problem using boundary conditions

5. Static analysis:
Plain and three Dimensional Trusses, Assembly of global matrix for the banded and skyline solutions, Beams and frames in various different conditions.

6. Dynamic Analysis:
Dynamic equation of motion, consistent mass matrix for truss element frame element and triangular plate element, evaluation of eigen values and eigen vectors

7. Solution of finite element equations:
Direct integration methods, central difference method, Houbolt method, Wilson method, Newmark method, mode superposition method,

BOOKS:
1. Finite Element Procedures in Engineering Analysis, Bathe , Prentice Hall of India
2. Introduction to Finite Element in Engineering by Chandrupatla and Belegundu from Prentice Hall of India
3. Concepts and Applications of Finite Element Analysis by Cook from John wiley

DE/ME-3.5 EXPERIMENTAL STRESS ANALYSIS

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

1. Basic elasticity: Laws of stress transformation, principal stresses and principal planes. Cauchy's stress quadric strain analysis, strain equations of transformation, Cauchy's strain quadric, stress, strain relationship
2. Two Dimensional photoelasticity: Stress optics law, Optics of polarisation plane and circular polariscope, dark and light field arrangements, fringe multiplication, fringe sharp ending, compensation techniques, commonly employed photo elastic materials
3. Dimensional photoelasticity; Neuman's strain optic relationship, stress freezing in model materials for three dimensional photoelasticity, shear difference method for stress separation.
4 Birefringence coatings: sensitivity, reinforcing effects, thickness of birefringence coatings.
5 Electric resistance strain gauges; Gauge construction and installation, temperature compensation, gauge sensitivities, gauge factor, corrections for transverse strain effects, factors affective gauge relation, rosetters Rosetre analysis, potentiometer and whetstone's bridge circuits for strain measurements.
6 Brittle coatings: Introduction, coating stresses and failure theories, different types of crack patterns, crack detection composition of brittle coatings, coating cure, influence of atmospheric conditions, effects of biaxial stress field.

Books

1. Experimental Stress Analysis by Dally and Rilley; McGraw Hill
2. Experimental Stress Analysis and Motion Measurement by Dow and Adams, Prentice Hall
3. Introduction to Photo Mechanics by Durelly and Riley, Prentice Hall

DE/ME-3.6 INDUSTRIAL TRIBOLOGY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction Tribological considerations ;Nature of surfaces and their contact; Physic-mechanical properties of surface layer

Geometrical properties of surfaces, methods of studying surfaces; Study of contract of smoothly and rough surfaces.

Friction and wear: Role of friction and laws of static friction, causes of friction , adhesion theory, Laws of rolling friction ; Friction of metals and non-metals; Friction measurements.

Definition of wear, mechanism of wear, friction affecting wear, wear measurement; Wear of metals and non-metals.

Lubrication and lubricants: Introduction, dry friction; Boundary lubrication; classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses; properties of liquid and grease lubricants; lubricant additives , general properties and selection.

Special Topics: Selection of bearing and lubricant; bearing maintenance, diagnostic maintenance of tribological components; lubrication systems; Filters and filtration.

BOOKS:

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

DE/ME-3.7 THEORY OF PLASTICITY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Introduction to Plasticity: Idealized stress-strain systems, approximate equation for stress strain curves (Ramberg-Osgood, Ludwig's and Karunes equations), Bauschinger effect-yield locus, yield surface,

Yield Criteria and Flow Rules: Tresca theory & Von-Mises yield criterion, their geometrical representation, experimental evidence for the criteria.

Slip Line Field Theory: Two-dimensional plasticity, slip lines, basic equations, Hencjy's first theorem, Geiringer's Velocity equation. Applications of slip line field theory to plane strain problems.

Load Bounding: The lower bound theorem, the upper bound theorem and their corollaries. Application of load bounding to plane strain problems.

Books

1. Plasticity for mechanical Engineers Johanson and Miller Van Nostrand
2. Engg Plasticity Calladina Pergmean Press

DE/ME-3.8 MECHATRONICS

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

10. INTRODUCTION TO MECHATRONICS: Definition and approach of Mechatronics, Measurement and Control Systems, Microprocessor based controllers and Mechatronics Approach

11. SENSORS AND TRANSDUCERS: Performance Terminology, Displacement, velocity, Position, Proximity, force, fluid pressure, liquid level, temperature, light sensors, procedure for selection

12. SIGNAL CONDITIONING: Op Amp, Protection, digital signals, Multiplexes and digital signal processing, pulse modulation

13. PNEUMATIC AND HYDRAULIC SYSTEMS: Actuation systems, Directions, pressure and process control valve, Pneumatic and hydraulic systems

14. ELECTRICAL ACTUATION SYSTEM: Mechanical Switches, Solid State Switches, Solenoid, DC/AC Motors, Stepper Motors

15. MICROPROCESSOR AND ITS APPLICATION: Architecture of Microprocssor 8085, Instruction set, Embedding a microprocessor into a Mechatronics system

16. MICROPROCESSOR BASED PROJECT: Assemble a suitable system using microprocessor kit for its control

Books

iv) Mechatronics: W. Bolton
v) Microprocessors : Rafiquzzaman
vi) Real time computer controls: S. Boennett.
vii) Automatic Control Systems Benjamin C. Kuo, Prentice Hall , New Delhi