5TH SEMESTER

MACHINE DESIGN-I

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UNIT I

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

Design for Static Load:Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.

UNIT II

Design for Fluctuating Loads Cyclic stresses, Fatigue and endurance limit, Stress concentration factor,Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.

UNIT III

Shafts:

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity.

UNIT IV

Mechanical Springs

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.

UNIT V

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.

Power Screws:Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jac

Note: Design data book is allowed in the examination

Books and References:

1. Design of Machine Elements,V.B. Bhandari, Tata McGraw Hill Co.

2. Machine Design-Sharma and Agrawal, S.K. Kataria&Sons.

3. Machine Design, U C Jindal, Pearson Eductaion.

4. Design of Machine Elements, Sharma and Purohit, PHI.

5. Design of Machine Elements-M.F. Spott, Pearson Eductaion

6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.

8. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

COMPUTER AIDED MACHINE DRAWING-I LAB

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UNIT-I

Introduction (1 drawing sheets)

Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning.

Orthographic Projections (3 drawing sheets)

Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

UNIT-II

Fasteners (2 drawing sheets):Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

UNIT-III

Riveted joints (1 drawing sheet):Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc.

Free hand sketching (1 drawing sheet)

Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

UNIT-IV

Assembly drawing (2 drawing sheets):Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

UNIT-V

Computer aided drafting (1 drawing)

Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software formodelling mechanical components.

Books and References:

Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.

Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.

Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.

Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.

Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.

Engineering Drawing, Pathak, Wiley.

Textbook of Machine Drawing, K C John, PHI.

AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY

HEAT & MASS TRANSFER

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UNIT-1

Introduction to Heat Transfer:

Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction :

General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems.Initial and boundary conditions.

Steady State one-dimensional Heat conduction :Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance.Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.

UNIT-2 Fins:Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

Transient Conduction:Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.

UNIT-3

Forced Convection:Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

Natural Convection :

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.

UNIT-4

Thermal Radiation :

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

UNIT-5

Heat Exchanger :

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

Condensation and Boiling:

Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convection boiling.

Introduction to Mass Transfer:Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Books:

1.Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons

2.Heat and Mass Transfer by Cengel, McGraw-Hill

3. Heat Transfer by J.P. Holman, McGraw-Hill

4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education

5. Heat Transfer by Ghoshdastidar, Oxford University Press

6. A text book on Heat Transfer, by Sukhatme, University Press.

7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd

8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill

HEAT & MASS TRANSFER – LAB

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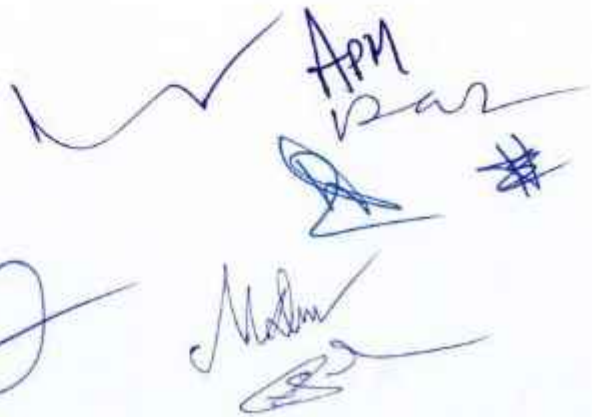
Minimum eight experiment of the following

1. Conduction – Experiment on Composite plane wall
2. Conduction – Experiment on Composite cylinder wall
3. Conduction - Experiment on critical insulation thickness
4. Conduction – Experiment on Thermal Contact Resistance
5. Convection - Pool Boiling experiment
6. Convection - Experiment on heat transfer from tube-(natural convection).
7. Convection - Heat Pipe experiment.
8. Convection - Heat transfer through fin-(natural convection) .
9. Convection - Heat transfer through tube/fin-(forced convection).
10. Convection - Determination of thermal conductivity of fluid
11. Experiment on Stefan's Law, on radiation determination of emissivity, etc.
12. Experiment on solar collector, etc.
13. Heat exchanger - Parallel flow experiment
14. Heat exchanger - Counter flow experiment



PRODUCTION TECHNOLOGY

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Unit I

Metal Cutting-Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Heat generation and cutting tool temperature, Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer, Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

Unit-II

Machine Tools

(i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout

(ii) Shaper, slotter, planer: Construction, operations & drives.

(iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.

(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

Unit-III

Grinding & Super finishing

(i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding.Centerless grinding

(ii) Super finishing: Honing, lapping and polishing.

Limits, Fits & Tolerance and Surface roughness:

Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

Unit-IV

B. Metal Joining (Welding)

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ

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Unit-V

C. Introduction to Unconventional Machining and Welding

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma- arc welding, Diffusion welding, Explosive welding/cladding. Introduction to Hybrid machining processes

Books and References:

1. Manufacturing Science – A. Ghosh and A.K. Mallik,Affiliated East-West Press
2. Fundamentals of Metal Machining and Machine Tools – Geoffrey Boothroyd, CRC Press
3. Production Technology - R.K. Jain Khanna Publishers.

MANUFACTURING TECHNOLOGY-II – LAB

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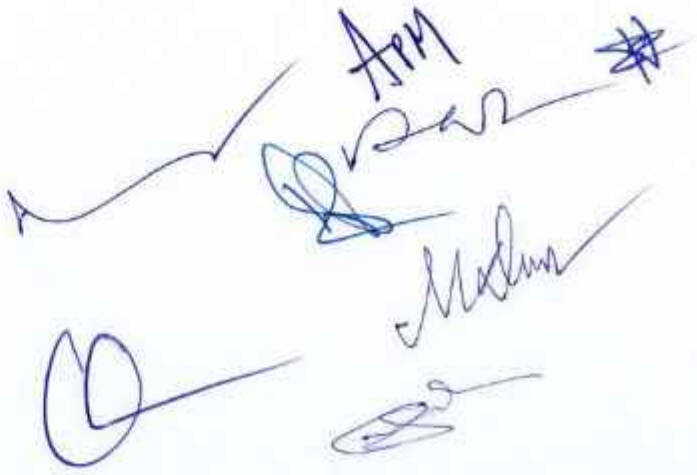
Minimum eight experiments out of the following along-with study of the machines / processes

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment



KINEMATICS OF MACHINES

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Unit I

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis:Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center .

Acceleration analysis:Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

Unit II

Cams

Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration,

Gears and gear trains

Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit III

Force analysis:Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turningmoment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

Unit IV

Balancing

Introduction,static balance, dynamic balance, balancing of rotating masses,two plane balancing, graphical and analytical methods, balancing of reciprocating masses,

Governors:Introduction, types of governors, characteristics of centrifugal governors, gravitycontrolled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

Unit V

Brakes and dynamometers:

Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Text/Reference Books:

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: AmitabhaGhosh and Ashok kumarMallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Mchines: S.S. Rattan, McGraw Hill
6. Theory of Mchines: Thomas Bevan, CBS Publishers.

ENGINEERING OPTIMIZATION

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UNIT I

Introduction:

Historical Developments, and Review of Engineering applications of Optimization Techniques Linear Programming:

Simplex method, Revised simplex method, Two phase method, Duality, Dual simplex method, Integer linear programming, 0-1 integer linear programming, solution by branch and bound method.

UNIT II

Classical Optimization Techniques: Introduction, Review of single and multivariableoptimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

UNIT-III

Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane methodand Method of Feasibledirections, Indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems

UNIT-IV

Unconstrained Optimization Techniques: Introduction, Direct search method - Random,Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric method, Examples.

UNIT-V

Geometric Programming: Introduction, Unconstrained minimization problems, solution ofunconstrained problem from arithmetic-geometric inequality point of view, Constrained minimization problems, Generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization.

Books and References:

1. Engineering Optimization by Ravindran, Wiley India
2. Engineering Optimization:Theory and Application by S SRao, Wiley India
3. Linear and Non Linear Programming by Luenberger , Narosa

ME-501	MANAGERIAL ECONOMICS
UNIT I	
The Scope and Methods of Managerial Economics, Risk, Uncertainty and Probability Analysis. Optimization techniques: Total, Average and Marginal Relationships, Optimization Analysis. Multivariate Optimization – Partial Derivatives; Contraint Optimization – by substitution, by Lagrangion Multiplier Method. Approach to Managerial Decision Making and the theory of firm.	
UNIT II	
Demand Analysis, Basic Concepts, and tools of analysis for demand forecasting. Use of business indicators; Demand forecasting for consumer, Consumer Durable and Capital Goods. Concepts in resource allocation, cost analysis; break even analysis, short run and long run cost functions; production functions; cost-price output relations – Capital Investment Analysis. Economics of size and capacity utilization; Input-Output Analysis.	
UNIT III	
Market Structure, Pricing and output; General Equilibrium. Pricing – Objectives – Pricing Methods and Approaches Product Line Pricing – Differential Pricing. Advertising – Contribution of Economic Theory, Methods of Determining Total Advertising Budget, Cyclical Fluctuations of Advertising, Measuring the Economic Effects of Advertising	
UNIT IV	
Capital Budgeting – Capital Management and Financial Policy – Monopoly Policy – Restrive Agreements – Price Discrimination – Measurement of Economic Concentration – Policy against Monopoly and Restrictive Trade Practices.	
UNIT V	
National Income and Product; Saving, Consumption, Investment, the theory of income determination.	
Text Books	
1. Dominick Salvatore, Managerial Economics in a Global Economy, 4th Edition, Thomson, 2001. 2. H. Craig Petersen, W. Cris Lewis, Managerial Economics, 4th Edition, Pearson Education, Asia, 2001. 3. Joel Dean, Managerial Economics, Prentice Hall India Ltd., 2001. 4. O.P. Chopra, Managerial Economics, New Delhi, Tata McGraw Hill 1985. 5. Paul A. Samuelson and William D. Nordhans,Economics, Tata McGraw Hill, New Delhi, 1998. 6. Maheswari : Manegerial Economics,PHI,2002.	

6TH SEMESTER

INDUSTRIAL MANAGEMENT

UNIT-1

Introduction:Concept, development, application and scope of industrial management.

Productivity:Definition, measurement, productivity index , types of production system, industrial ownership.

UNIT-2

Management function:Principles of management- management tools – time and motion study, work simplification- process charts and flow diagrams, production planning, specification of production requirements.

UNIT-3

Inventory control:Inventory, cost, deterministic models , introduction to supply chain management.

UNIT-4

Quality control:Meaning, process control, SQC control charts , single, double and sequential sampling, introduction to TQM.

UNIT-5

Environmental issues :Environmental pollution- various management techniques to control environmental pollution- various control acts for air, water , solid waste and noise pollution.

FLUID MACHINERY

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UNIT-I

Introduction: Impulse of Jet and Impulse Turbines:

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat &curve), Classification of turbines, Impulse turbines, Constructional details, Velocitytriangles, Power and efficiency calculations, Governing of Pelton wheel

UNIT-II

Reaction Turbines:Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

UNIT-III

CentrifugalPumps:Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics.

UNIT-IV

Positive Displacement and other Pumps:Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

UNIT-V

Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift, hydraulic Ram,hydraulic coupling, hydraulic torque converter, air lift pump, jet pump.

BOOKS:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
2. Hydraulic Machines by K Subramanya, Tata McGraw Hill
3. Fluid Mechanics and Machinery by C.S.P.Ojha, R. Berndtsson, P.N. Chandramouli, Oxford University Press
4. Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria& Sons
5. Fluid Mechanics and Turbo machines by Das, PHI
6. Fluid Power with Applications, by Esposito, Pearson
7. Fluid Mechanics and hydraulic machines by Modi& Seth, Standard Book House
8. Fundamentals of Turbomachinery by Venkanna B.K., PHI
9. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
10. Fluid Mechanics and Hydraulic Machines by SukumarPati, Tata McGraw Hill

FLUID MACHINERY Lab

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Minimum ten experiments out of the following along with study of the machines and processes

1. Impact of Jet experiment.
2. Experiment on Pelton wheel.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

DYNAMICS OF MACHINES

UNIT I

FORCE ANALYSIS

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of

Cam- follower mechanism.

UNIT II

BALANCING

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III

SINGLE DEGREE FREE VIBRATION :

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV

FORCED VIBRATION

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V

MECHANISM FOR CONTROL

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms" ,3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009

THEORY OF MACHINES LAB

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Minimum eight experiments out of the following:

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

MACHINE DESIGN-II

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UNIT I

Principle of transmission and conjugate action

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears

Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength& wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

UNIT II Bevel

Gears:Terminology of bevel gears, Force analysis, Virtual number of teeth, Beam strength and wear strength of bevel gears,Effective load of gear tooth, Design of a bevel gear system.

Worm Gears:Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system.

UNIT III

Sliding Contact Bearing:Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials,Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing,

Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing,

UNIT IV

Rolling Contact Bearing

Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing

UNIT V

IC ENGINE parts,Selection of type of IC engine, General design considerations, Design of cylinder and cylinder head; Design of piston and its parts like piston ring and gudgeon pin etc.; Design of connecting rod; Design of crankshaft

Note: Design data book is allowed in the examination

Books and References:

1. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

2. Machine Design-Sharma and Agrawal, S.K. Kataria& Sons.

3. Machine Design, U C Jindal, Pearson Eductaion.

4. Design of Machine Elements, Sharma and Purohit, PHI.

5. Design of Machine Eesign-M.F. Spott, Pearson Eductaion

6. Machine Design-Maleev and Hartman, CBS Publishers.

7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.

9. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

MACHINE DESIGN LAB-2

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A. Computer and Language :students are required to learn the basics of computer language such as Cand C++ so that they should be able to write the computer programme (*3practical turns*)

B. Writing Computer programme for conventional design: Students are required to write computerprogram and validate it for the design of machine components done in theory subject (*5practicalturns*)

C. Mini Project: Each student will be given a real life problem for the complete design of asubsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

REFRIGERATION & AIR CONDITIONING

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Unit-1

Refrigeration:Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2

Vapour Compression System:Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

Unit-3

Vapour Absorption system; Working Principal of vapour absorption refrigeration system, Comparison between absorption &compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system.

Refrigerants:

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants

Unit-4

Air Conditioning:Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers & humidifying efficiency.

Unit-5

Refrigeration Equipment & Application:Elementary knowledge of refrigeration & air conditioning equipmentse.g compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill

2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.

3. Refrigeration and Air conditioning by R. C. Arora, PHI

4. Principles of Refrigeration by Roy J. Dossat. Pearson Education

5. Refrigeration and Air conditioning by stoecker& Jones. McGraw-Hill

7. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai

7. Thermal Environment Engg. byKuhen, Ramsey &Thelked.

REFRIGERATION & AIR CONDITIONING Lab

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Study of different types of expansion devices used in refrigeration system.
3. Study of different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. Experiment on air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.

MECHANICAL VIBRATIONS

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UNIT - I

Introduction, Classification of Vibration Systems, Harmonic motion, Vector re[presentation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods.

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT – II

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments

UNIT- III

Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT- IV

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

8

UNIT- V

Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method

Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

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Books and References:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.

2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.

3. Mechanical Vibrations-Theory & Applications, Singhal, Katson Books.

4. Theory of Vibrations with Applications, Thomson&Dahleh, Pearson Education.

5. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.

6. Mechanical Vibrations – Tse, Morse & Hinkle

7. Mechanical Vibrations – V. Rama Murthy, Narosa Publications

8. Mechanical Vibrations – D. Nag, Wiley