BT-106 **MM: 70**

RME-101/RME-201: ELEMENTS OF MECHANICAL ENGINEERING

UNIT-I:

Force System: Force, Parallelogram Law, Lami's theorem, Principle of Transmissibility of forces. Moment of a force, Couple, Varignon's theorem, Resolution of a force into a force and a couple. Resultant of coplanar force system. Equilibrium of coplanar force system, Free body diagrams, Determination of reactions.

Concept of Centre of Gravity and Centroidand Area Moment of Inertia, Perpendicular axis theorem and Parallel axis theorem **9**

UNIT-II:

Plane Truss: Perfect and imperfect truss, Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

Beams: Types of beams, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment. **8**

UNIT-III:

Simple stress and strain: Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series. Tensile Test diagram for ductile and brittle materials, Elastic constants, Strain energy.

Bending (Flexural) Stresses: theory of pure bending, neutral surface and neutral axis, stresses in beams of different cross sections.

Engineering Materials: Importance of engineering materials, classification, mechanical properties and applications of Ferrous, Nonferrous and composite materials. **8**

UNI-IV:

Basic Concepts and Definitions of Thermodynamics: Introduction and definition of thermodynamics, Microscopic and Macroscopic approaches, System, surrounding and universe, Concept of continuum, Thermodynamic equilibrium, Thermodynamic properties, path, process and cycle, Quasi static process, Energy and its forms, Work and heat. Thermodynamic definition of work.

Zeroth law of thermodynamics: Temperature and its' measurement.

First law of thermodynamics: First law of thermodynamics, Internal energy and enthalpy. First law analysis for non-flow processes. Non-flow work Steady flow energy equation; Boilers, Condensers, Turbine, Throttling process, Pumps etc. **8**

UNIT-V:

Second law: Thermal reservoir, Kelvin Planck statement, Heat engines, Efficiency; Clausius' statement Heat pump, refrigerator, Coefficient of Performance. Carnot cycle, Carnot theorem and it's corollaries.Clausius inequality, Concept of Entropy.

Properties of pure substances: P-v, T-s and h-s diagram, dryness fraction and steam tables. Rankine Cycle.

Internal Combustion Engines: Classification of I.C. Engines and their parts, working principle and comparison between 2 Stroke and 4 stroke engine , difference between SI and CI engines. P-v and T-s diagramsof Otto and Diesel cycles, comparison of efficiency. **9**

Books & References:

1. Engineering Mechanics: Statics by J.L Meriam , Wiley
2. Engineering Mechanics : Statics and Dynamics by R. C. Hibbler, Pearson
3. Strength of Materials by Thimoshenko& Young
4. Mechanics of Solid by R. C. Hibbler, Pearson
5. Engineering Thermodynamics by P.K.Nag, McGraw Hill
6. Thermodynamics An Engineering Approach by Cengel& Boles, McGraw Hill
7. Engineering Thermodynamics by P. Chattopadhyay, OXFORD Publication
8. Internal Combustion Engine by V Ganesan, McGraw Hill Pub .
9. An Introduction to Mechanical Engineering by Wickert& Lewis, Cengage Learning
10. Engineering Mechanics By S. S. Bhavikatti, K. G. Rajashekarappa, New Age International
11. Engineering Mechanics by R K Bansal, Laxmi Publications
12. Fundamentals of Mechanical Engineering by Sawhney, PHI
13. Basic Mechanical Engineering by Pravin Kumar, Pearson
14. Basic Mechanical Engineering by Agrawal&Agrawal, Wiley
15. Elements of Mechanical Engineering by Singh, Anne Books Pvt Ltd
16. Elements of Workshop Technology by Hajra Choudhary Media Promoter

BT- 156 RME-151/RME-251: ELEMENTS OF MECHANICAL ENGINEERING LAB MM: 100

Note: Any 10 experiments (Minimum of 3 from each module) are to be conducted

Module 1:

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen.
2. To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the Impact Strength of the specimen.
3. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
4. To conduct experiment on Torsion of Rod/wire.

Module 2:

1. To Study the working of 2 stroke Diesel/Petrol engine.
2. To Study and working of 4 stroke Petrol/Diesel engine.
3. To Study the model of Babcock and Wilcox and Lancashire boiler.
4. To Study various types of Mounting and Accessories of Boilers.

Module 3:

1. To verify the parallelogram, and Triangle law.
2. To verify the polygon law of force.
3. To determine the coefficient of friction on inclined surface.
4. To determine the efficiency and Mechanical Advantage of Worm & Worm-wheel.
5. To conduct experiment on Force Analysis on simple truss and Jib-crane Apparatus.
6. To conduce friction experiment on screw-jack.

BT-312 RME301: MATERIAL SCIENCE MM: 70

UNIT-I

Introduction: Importance of materials, historical perspective, Future aspects of engg. materials.

Crystal Structure: brief on BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion.

Ferrous and non- ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys. Introduction to BIS & ASTM codes and practice on material and testing.

UNIT-II

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests.

Fracture Creep Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

UNIT-III

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase DiagramI: Solid solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediatephases, Gibbs phase rule. **Phase Diagram:** Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

UNIT-IV

Heat Treating of Metals: TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, mastempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.Comparativestudyof microstructureof various Ferrous,nonferrous metals andalloys.

UNIT-V

Composite materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites. **Ceramics:** Structure types and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics.

Plastics: Various types of polymers/ plastics and its applications. Mechanical behaviour and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications.

Books and References:

1. Callisters Materials Science and Engineering, by William D. Callister, Jr, (Adopted by R.Balasubramaniam), Wiley India Pvt. Ltd.
2. Elements of Material Science & Engineering by Van Vlack, Pearson
4. Material Science and Engineering by Smith, Hashemi and Prakash, MCGRAW HILL INDIA
5. The Science and Engineering of materials, by Askeland & Balani, Cengage Learning
6. Introduction to Materials Science for Engineers by Shackelford, Pearson
7. Material Science by Narula ,MCGRAW HILL INDIA.
8. Materials Science and Engineering - A First Course by Raghavan, PHI
9. Material Science and Engineering Properties by Gilmore, Cengage Learning
10. Material Science for Engineering Students by Fischer, Academic Press
11. Technology of Engineering materials by Philip and Bolton, Butterworth-Heinamann

BT- 314 RME302: THERMODYNAMICS MM: 70

UNIT–I

Review of Fundamental Concepts and Definitions: Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases. **Zeroth law of thermodynamics:** Concept of Temperature and its' measurement, Temperature scales. 4

First law of thermodynamics: Thermodynamic definition of work, Displacement work and flow work, Displacement work for various non flow processes, Joules' experiment, First law analysis for closed system (non flow processes), Internal energy and enthalpy. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy

equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer. 4

UNIT–II

Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II 4

Entropy : Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. 4

UNIT–III

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function. 2

Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility. 4

UNIT–IV

Properties of steam and Rankine cycle: Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam -Tables &Mollier chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. 5

Air-water vapour mixture and Psychrometry: Psychometric terms and their definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart. 3

UNIT–V

Refrigeration Cycles: Reversed Carnot Cycle for gas and vapour. Refrigeration capacity, unit of refrigeration.Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system. 8

Books and References:

1. Basic and Applied Thermodynamics by P.K.Nag, MCGRAW HILL INDIA
2. Thermodynamics for Engineers by Kroos& Potter, Cengage Learning
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by C.P. Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
12. Engineering Thermodynamics by Mishra, Cengage Learning
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL INDIA

BT- 313 RME303: MECHANICS OF SOLIDS MM: 70

UNIT-I

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional state of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses. 8

UNIT –II

Stresses in Beams: Pure Bending**,** normal stresses in beams,shear stresses in beams due to transverse and axial loads, composite beams. 2

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams 4

Torsion: Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes 2

UNIT-III

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. 4

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines. 4

UNIT-IV

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, Thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. 2

Thick cylinders:

Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits. 4

UNIT-V

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression. 4

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Books and References:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MCGRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Yσungs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MCGRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Material by Rattan, MCGRAW HILL INDIA
12. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

BT- 362 RME351: MATERIALS SCIENCE AND TESTING LAB MM: 100

In this lab Experiments on Material Science and Experiments on Material Testing are to be conducted as given below:

(A). Experiments on Material Science (at least 5 of the following):

1. Preparation of a plastic mould for small metallic specimen.
2. Preparation of specimen for micro structural examination-cutting, grinding, polishing, etching.
3. Determination of grain size for a given specimen.
4. Comparative study of microstructures of different specimens of different materials (mild steel, gray C.I., brass, copper etc.)
5. Experiments on heat treatment such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after heat treatment.
6. Material identification of, say, 50 common items kept in a box.
7. Experiment on Faraday's law of electrolysis.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & micro examination of the welded specimen.
10. Study of Magnetic/ Electrical/Electronic materials.

(B) Experiments on Material Testing (at least 5 of the following):

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion test of a rod using torsion testing machine.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

BT- 364 RME352: THERMODYNAMICS LAB MM: 100

Minimum 10 experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance sheet for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine
11. Study of Pressure compounded steam turbine
12. Study of Impulse & Reaction turbine
13. Study of steam Engine model.
14. Study of Gas Turbine Model
15. Any other suitable experiment(s) on thermodynamics

BT- 363 RME353: COMPUTER AIDED MACHINE DRAWING-I LAB MM: 100

Introduction (1 drawing sheets)

Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning 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 Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws,

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

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. 2 **Free hand sketching (**1 drawing sheet**)**
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.

Books and References:

1. Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House
3. Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age
5. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
6. Engineering Drawing, Pathak, Wiley
7. Textbook of Machine Drawing, K C John, PHI
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY
9. Engineering Graphics with AutoCAD, Bethune, PHI

BT-311 **RCE303: FLUID MECHANICS** **MM:70**

UNIT I

Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

UNIT II

Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential.

UNIT III

Potential Flow: source, sink, doublet and half-body. Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.

UNIT IV

Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control.

UNIT V

Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance.

References:

1. Hibbler, "Fluid Mechanicsin SI Units" 1/e Pearson Education, Noida.
2. Fox & Donald, "Introduction to Fluid Mechanics" John Wiley &Sons Pvt Ltd,
3. Cengel & Cimbala,"Fluid Mechanics" TMH, New Delhi.
4. Katz, "Introductory Fluid Mechanics" Cambridge University Press
5. Pnueli & Gutfinger, "Fluid Mechanics" Cambridge University Press
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. Gupta, "Fluid Mechanics & Hydraulic Machines" Pearson Education, Noida
8. Graebel, "Engineering Fluid Mechanics", CRC Press Taylor & Francis Group.
9. Janna, "Introduction to Fluid Mechanics" 4/e, CRC Press Taylor & Francis Group.
10. AK Jain "Fluid Mechanics" Khanna Publication.
11. White,F.M. "Fluid Mechanics" TMH, New Delhi.
12. Munsen et al , "Fundamental of Fluid Mechanics" Wiley Newyork Ltd
13. Garde, R.J., " Fluid Mechanics", SciTech Publications Pvt. Ltd
14. I.H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student.
15. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication
16. Jagdish Lal "Fluid Mechanics"
17. N Narayan Pillai " Principles of Fluid Mechanics & Fluid Machines" Universities Press.
18. Esposito, Fluid Power & Applications" 7/e Pearson Education, Noida.
19. DR Malhotra & Malhotra, "Fluid Mechanics Hydraulics & Hydraulic Machines" Satya Prakashan, New Delhi.

BT- 361 **RCE353: FLUID MECHANICS LAB** **MM:100**

Note: Ensure to conduct at least 10 experiments from the list:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To draw a flow-net using Electrical Analogy Method.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
11. To determine Meta-centric height of a given ship model.
12. To determine the head loss for a sudden enlargement
13. To determine the head loss for a sudden Contraction.

BT- 516 NME-501: MACHINE DESIGN-I MM:75

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. **3**

Design for Static Load Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure. **4**

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. **4**

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. **4**

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. **4**

Keys and Couplings Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings. **4**

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. **4**

Power Screws Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack **3**

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.

BT- 517 NME-502: KINEMATICS OF MACHINES MM: 100

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. **4**

Velocity analysis:

Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, rubbing velocity at a pin joint, instantaneous center method, types and locations of instantaneous center, Kennedy's theorem, velocities in four bar mechanism and slider crank mechanism. **4**

Unit II

Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism, Klein's construction for slider crank mechanism and four bar mechanism, analytical method for slider crank mechanism. **4**

Kinematic synthesis of mechanism: Introduction, dimensional synthesis of mechanisms, motion, path and function generation, Chebyshev spacing, three position synthesis, graphical approach for four link mechanisms, straight line mechanisms, special mechanisms – indicator diagram mechanisms, steering mechanisms, Hook's Joint **4**

Unit III

Cams

Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, simple harmonic and cycloidal motions of follower. Analytical methods for cam profile. **8**

Unit IV

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, interference and undercutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train. **8**

Unit V

Friction drives Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, power transmission, effect of mass of belt on power transmission, maximum power transmission, initial tension and maximum tension, pivots and collars, uniform pressure and uniform wear, clutches. **8**

Books:

1. Theory of Mechanisms and Machines: A Ghose and A K Malik, East West Press Pvt Ltd.
2. Theory of Mechanisms and Machines: J JUicker, G R Pennock and J E Shigley, Oxford University Press.
3. Kinematics and dynamics of machinery: C E Wilson and J E Sadler: PEARSON
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Machines: S S Rattan, McGraw Hill
6. Theory of Machines: Thomas Bevan, Pearson

BT-518 NME-503: MANUFACTURING SCIENCE& TECHNOLOGY-II

MM: 100

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. **9**

Unit-II

Machine Tools (i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout **2**
(ii) Shaper, slotter, planer: Construction, operations & drives. **1**
(iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. **2**
(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills. **2**

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 **4**

(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. **3**

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. **10**

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 **6**

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.
4. Introduction to Manufacturing Processes – John A. Schey ,McGraw-Hill
5. Production Engineering Science - P.C. Pandey,Standard Publishers Distributors,
6. Modern Machining Processes - P.C. Pandey& H.S. Shan, McGraw-Hill
7. Degarmo's Materials and Processes in Manufacturing - Ernest P. De Garmo, J. T. Black, Ronald A. Kohser, Wiley
8. Fundamentals of Metal Cutting & Machine Tools – B.L. Juneja& G.S. ShekhonWiley
9. Process &Materials of Manufacturing – R.A. Lindburg, Pearson Eductaion
10. Advanced Machining Process - VK Jain ,Allied Publishers
11. Manufacturing Engineering & Technology, -Kalpakjian, Pearson
12. Manufacturing Technology Part I and Part II,-Rao,PN, McGraw-Hill

BT-519 NME-504: HEAT & MASS TRANSFER MM:100

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. **2**

Conduction : General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems.Initial and boundary conditions. **3**

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. **3**

UNIT-2

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. **3**

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. **5**

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. **5**

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. **3**

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. **8**

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. **3**

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. **3**

Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. **2**

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
9. Heat and Mass Transfer by R Yadav, Central Publishing House

BT-520 NME-505 : I C ENGINES & COMPRESSORS MM:100

Unit-1

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram. Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycles, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle. **8**

Unit–II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect **9**

Unit–III

CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings Exhaust emissions from SI engine and CI engine and it's control **9**

Unit-IV

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. Fuels: Fuels for SI and CI engine , Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines **9**

Unit V

Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor , Axial compressors, Surging and stalling, Roots blower, Vaned compressor. **7**

BOOKS:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill Pub.
9. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek,,Pearson Eductaion

BT-566 NME-551 : MACHINE DESIGN-I Lab MM:50

Minimum eight experiments out of the following are to be performed. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

BT-568 NME-553 : MANUFACTURING TECHNOLOGY -II – LAB MM:50

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
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints.

BT-569 NME-554: HEAT & MASS TRANSFER – LAB MM: 50

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

BT-723 NME-701: COMPUTER AIDED DESIGN (CAD) MM: 100

UNIT-I

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-I CAD/CAM systems,

Computer Graphics-I Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices- Cathode Ray Tube, Random & Raster scan display, Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters **8**

UNIT-II

Computer Graphics-II Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations- Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation . **8**

UNIT-III

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves **8**

UNIT-IV

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models. Basic application commands for 2d drafting software like AutoCAD/Draftsight (any one)&3d solid modeling software Solidworks/Autodesk Inventor/PTC Creo /Catia (Any one)etc. **8**

UNIT-V

Finite Element Analysis: Basic concept of the finite element method, comparison of FEM with direct analytical solutions; Steps in finite element analysis of physical systems, Finite Element analysis of 1-D problems like spring, bar, truss and beam elements formulation by direct approach; development of elemental stiffness equations and their assembly, solution and its post processing. **8**

Books and References:

1. Computer Graphics, by Hearn & Baker, Prentice Hall of India
2. CAD/CAM, by Groover and Zimmers, Prentice Hall India Ltd.
3. CAD/CAM :Theory and Practice, by Zeid, McGraw Hill
4. CAD/CAM: Computer Aided Design and Manufacturing, by Groover, Pearson India
5. Mathematical Elements for Computer Graphics, buy Rogers and Adams, McGraw Hill
6. Finite Element Method By S S Rao
7. FE Analysis Theory and Programming, by Krishnamoorthy, Tata McGraw Hill

BT-724 NME-702: AUTOMOBILE ENGINEERING MM: 100

UNIT-I

Introduction: Basic concepts of Automobile Engineering and general configuration of an automobile, Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination. **6**

UNIT-II

Transmission System: Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer. **8**

UNIT-III

Braking System: General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. **5**

Chasis and Suspension System: Loads on the frame, Strength and stiffness, Independent front & rear suspension, Perpendicular arm type, Parallel arm type, Dead axle suspension system, Live axis suspension system,Air suspension & shock absorbers. **5**

UNIT-IV

Electrical System: Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc. **5**

Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI. **4**

UNIT-V

Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives and modern trends in automotive engine efficiency and emission control. **5**

Maintenance system: Preventive maintenance, break down maintenance and over hauling. **2**

Books and References:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automobile Engineering –TTTI, Pearson India
5. Automotive Mechanics- Crouse
6. Automobile Engineering - Newton and Steeds.
7. Automobile Engineering –Ramakrishna, PHI, India

BT-773 NME-751:CAD/CAM LAB MM:50

Total TEN Experiments are to carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments
1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

BT-771 NME-752: I.C. ENGINES AND AUTOMOBILE LAB MM: 50

Experiments : Say minimum 10 experiments out of following in depth and details.
1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

BT-721 NME-031: COMPUTER AIDED MANUFACTURING (CAM) MM: 100

UNIT-I

Introduction to Automation: Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. 8

UNIT-II

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system. Definition and designation of control axes, Constructional details of Numerical Control Machine Tools, MCU structure and functions, Methods of improving accuracy and productivity using NC. 8

UNIT -III

Computer Numerical Control (CNC) : Features of CNC, Elements of CNC machines, the machine control unit for CNC , Direct Numerical Control(DNC) and Adaptive Controls. System Devices: Drives, Feedback devices, Counting devices, DAC and ADCs, Interpolator systems, Control loop circuit elements in PTP system, Contouring system, Incremental and absolute systems. 8

UNIT -IV

NC Part Programming- (a) Manual (word address format) programming Examples Drilling,Turning and Milling; canned cycles, Subroutine, and Macro.

(b) Computer Assisted Part programming (APT) Geometry, Motion and Additional statements, Macro- statement. 8

UNIT-V

Computer Integrated manufacturing system , Group Technology, Flexible Manufacturing System, Computer aided process planning-Retrieval and Generative System. Types and generations of Robots, Structure and operation of Robot, Robot applications. 8

Books and References:

1. Automation, Production System and Computer Integrated Manufacturing, by Mikell P. Grover, Prentice Hall of India Pvt Ltd.
2. CAD/CAM – Theory and Practice, by Ibrahim Zeid, McGraw Hill
3. Computer Aided Manufacturing, by Cheng, Pearson India
4. CAD/CAM: Principles and Oerations, by P. N. Rao, McGraw Hill
5. CAD/CAM: Computer Aided Design and Manufacturing, by M. Groover, Pearson India.
6. CAD/CAM: Concepts and Applications by Alavala, PHI India
7. Computer Aided Manufacturing, by Srinivas, Oxford University Press.

BT-722 NME – 043: MECHANICAL SYSTEM DESIGN MM: 100

UNIT-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing. **4**

Problem Formulation : Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A casestudy: heating duct insulation system, high speed belt drive system. **4**

UNIT-II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. **4**

System modeling

Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system. **4**

UNIT-III

Graph Modeling and Analysis

Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system. **4**

Optimization Concepts

Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system. **4**

UNIT-IV

System Evaluation

Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. **4**

Calculus Method for Optimization

Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulationsystem. **4**

UNIT-V

Decision Analysis

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. **4**

System Simulation
Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant. **5**

Books and References:
1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Engineering Design, by Dieter, McGraw Hill
3. Design Engineering-JR Dixon, TMH, New Delhi
4. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
5. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
6. Optimization Techniques-SS Rao
7. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

BT-701 NME-051: OPERATIONS RESEARCH MM: 100

UNIT-I
Introduction: Basic of Operation Research, Origin & development of Operation Research,Applications. **2**
Linear Programming: Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis. **7**

UNIT-II
Transportation Problem: Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem. **4**

Assignment Problem: Methods of obtaining optimum solution, Maximization problem, travelling salesman problem. **3**

UNIT-III
Game Theory: two person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming. **4**

Sequencing: Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines. **3**

UNIT-IV
Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy. **4**

Simulation: Use, advantages & limitations, Monte-carlo simulation, Application to queuing, inventory & other problems. **4**

UNIT-V
Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration. **3**

Project management: Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation. **6**

Books and References:
1. Operations Research: Principles and Practice, by- Ravindran, Phillips, Solberg, John Wiley & Sons.
2. Principal of Operation Research, by- Harvey M. Wagner, Prentice Hall.
3. Introduction to Operation Research, by- Gillett, McGraw Hill.
4. Operations Research - An Introduction, by- Hamdy A. Taha, Pearson India.
5. Operation Research, by- Wayne L. Winston, Thomsan Learning.
6. Problems in Operations Research by- Prem Kumar Gupta & D.S. Hira, S. Chand.
7. Operation Research Application and Algorithms, by- Wayne L Winston, Duxbury Press.
8. Operations Research, by Jha, McGraw Hill.
9. Operation Research, by Yadav & Malik Oxford University Press
10. Operations Research, by Panneerselvam, PHI, India

ELECTRICAL MACHINES & CONTROLS

BT-411 **ME-IV SEM** **MM:70**

UNIT-I

Single phase Transformer: Efficiency Voltage regulation, O.C.& S.C. Tests. 2

Three Phase Transformer: Three phase transformer connections, 3-phase to 2-phase or 6- phase connections and their applications. 2

Auto Transformer: Volt- Amp relations, efficiency, advantages & disadvantages, applications. 1

D.C. Motors: Concept of starting, speed control, losses and efficiency. 3

UNIT-II

Three phase Induction Motor: Construction, equivalent circuit, torque equation and torque-slip characteristics, speed control. 3

Alternator: Construction, e.m.f. equation, Voltage regulation and its determination by synchronous impedance method. 3

Synchronous Motor: Starting, effect of excitation on line current (V-curves), synchronous condenser. 2

Servo Motor: Two phase a.c. servo motor & its application. 1

UNIT-III

Modeling of Mechanical System: linear mechanical elements, force -voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems. 4

Control System: Open loop & closed loop controls, servo mechanisms; concept of various types of system. 2

Signals: Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics**.** 1

UNIT-IV

Time Response Analysis: Time response of a standard second order system and response specifications, steady state errors and error constants. 2

Stability: Concept and types of stability, Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability. 6

UNIT-V

Root Locus Techniques: Concept of root locus, construction of root loci.

Frequency Response Analysis: Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar pl 4

Process control: Introduction to P, PI and PID controllers their characteristics, representation and applications. 1

Text and Reference Books:

1. I. J. Nagrath & D. P. Kothari, “Electrical machines” Tata McGraw Hill.
2. B.R. Gupta & Vandana Singhal, “Fundamentals of Electrical Machines”, New Age International.
3. K. Ogata, “Modern Control Engineering” Prentice Hall of India.
4. B.C. Kuo, “Automatic Control systems.” Wiley India Ltd.
5. Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India.
6. D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India.
7. M. Gopal, Control Systems: Principles and Design” Tata McGraw Hill.

MEASUREMENT AND METROLOGY

BT-412 **ME-IV SEM** **MM: 70**

UNIT-I

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept–Generalized measurement system and its elements-Unit sand standards-measuring instruments: sensitivity, stability, range, accuracy and precision- static and dynamic response- repeatability-systematic, Source of error, statistical analysis of error and random errors- correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT-II

Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of verylow pressures (high vacuum).

Strain Measurement: Types of strain gauges andtheir working, straingauge circuits, temperature compensation. Strain rosettes, calibration.

UNIT-III

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter

Temperature Measurement: Thermometers, bimetallicthermocouples, thermistors and pyrometers.

Measurements of Force, Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments

Measurements of Acceleration, and Vibration: Accelerometers vibration pickups and decibel meters, vibrometers.

UNIT-IV

Coordinate measuring machine (CMM): Need, constructional features and types,

Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measurements devices and systems **Comparators:** Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

UNIT-V

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator.

Interferometry: principle and useof interferometry, optical flat. Measurement of screw threads andgears.Surface texture: quantitative evaluation of surface roughness and its measurement.

Books and References:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
6. Hume K.J., "Engineering Metrology", MacDonald and Co
7. Jain, R.K., "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers
9. Gupta S.C, Engineering Metrology, Dhanpat Rai Publications

MANUFACTURING SCIENCE & TECHNOLOGY-I

BT-413 **ME-IV SEM** **MM: 70**

UNIT-I

Introduction:

Importance of manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items. 2

Metal Forming Processes:

Elastic & plastic deformation, yield criteria (Mises' and Tresca's). Hot working versus cold working. 2

Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction, sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. 5

UNIT-II

Metal Forming Processes (continued):

Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. 3

Condition for Rolling force and power in rolling. Rolling mills & rolled-sections. 2

Design, lubrication and defects in metal forming processes.

UNIT-III

Sheet Metal working :

Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs. Piercing. Compound vs. Progressive die. Flat-face vs Inclined-face punch and Load (capacity) needed.

Analysis of forming process like cup/deep drawing. Bending & spring-back. 3

UNIT-IV

Casting (Foundry)

Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand, sand testing. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting, Sand casting, defects & remedies and inspection.Cupola furnace. 7

Die Casting, Centrifugal casting, Investment casting, Continuous casting, CO2 casting and Stir casting etc. 3

UNIT-V

Unconventional Metal forming processes :

Unconventional metal forming or High Energy Rate Forming (HERF) processes such as explosive forming, electromagnetic, electro-hydraulic forming. 2

Powder Metallurgy :

Introduction to Powder metallurgy manufacturing process.Application and, advantages. 1

Jigs & Fixtures :

Locating & Clamping devices & principles. Jigs and Fixtures and its applications. 2

Manufacturing of Plastic components :

Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives. 2

Books and References:

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Manufacturing Engineering & Technology by Kalpakjian, Pearson
4. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA
5. Manufacturing Processes by Lindberg, Pearson.
6. Manufacturing Processes foe Engineering materials by Kalpakjian, Pearson
7. Materials and Manufacturing by Paul Degarmo.
8. Manufacturing Processes by Kaushish , PHI
9. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
10. Production Technology by R.K. Jain

APPLIED THERMODYNAMICS

BT-414 **ME-IV SEM** **MM: 70**

UNIT-I

Gas power cycle: Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles. 5

I.C. Engine: Testing of two stroke and four stroke SI and CI engines for performance Related numerical problems, heat balance, Motoring Method, Willian's line method, swinging fiel dynamometer, Morse test

UNIT-II

Vapour Power cycles: Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. 4

Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio,standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature. 4

UNIT-III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. 6

Condenser: Classification of condenser, air leakage, condenser performance parameters. 2

UNIT-IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, Choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock wavesstationary normal shock waves, Effect of friction on nozzle, Super saturated flow. 4

Steam Turbines : Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines,Governing of turbines, Comparison with steam engine. 4

UNIT-V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. 4

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine. 4

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2. Applied thermodynamics by Onkar Singh, New Age International
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education
4. Applied Thermodynamics by Venkanna And Swati, PHI
5. Theory of Stream Turbine by W.J. Kearton
6. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
7. Gas Turbine, by V. Ganeshan, Tata McGraw Hill Publishers.
8. Steam & Gas Turbine by R. Yadav, CPH Allahabad
9. Thermodynamics and Energy Systems Analysis, Borel and Favrat, CRC Press
10. Thermodynamics by Prasanna Kumar, Pearson
11. Thermal Engineering by Kulshrestha, Vikas Publishing.
12. Thermal Engg. By P.L. Ballaney, Khanna Publisher
13. Thermal Engg. By R.K. Rajput, Laxmi Publicatio

ELECTRICAL MACHINES & CONTROLS LAB

BT-461 **ME-IV SEM** **MM: 100**

Note: To perform at least 7 experiments of Electrical Machines and 3 experiments of Control Systems

A. Electrical Machines

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine (a) speed- torque characteristics (b) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using (a) Voltage Control (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

B. Control Systems:

1. To determine transient response of a second order system for step input for various values of constant ‘K’ using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a.c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector(RTD)
5. To study dc servo position control system within P and PI configurations.
6. To study synchro transmitter and receiver system and determine output V/s input characteristics.
7. To study open loop and closed loop control of a dc separately excited motor.

MEASUREMENT & METROLOGY LAB

BT-462 **ME-IV SEM** **MM: 100**

Minimum 8 experiments out of following (or such experiment) are to be performed:

1. Study the working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sinebar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances.
10. Experiment on measurement of pressure.
11. Study of temperature measuring equipments.
12. Measurement using Strain gauge.
13. Measurement of speed using stroboscope.
14. Experiment on measurement of flow.
15. Measurement of vibration/power.
16. Experiment on dynamometers.
17 To study the displacement using LVDT.

MANUFACTURING TECHNOLOGY-I LAB

BT-463 **ME-IV SEM** **MM: 100**

Minimum 8 experiments out of following (or such experiment) are to be performed:

1. Design of pattern for a desired casting (containing hole).
2. Pattern making with proper allowance.
3. Making a mould (with core) and casting.
4. Sand testing methods (at least one, such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging - hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

COMPUTER AIDED MACHINE DRAWING-II LAB

BT-464 **ME-IV SEM** **MM: 100**

Note: All drawing conform to BIS Codes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modeling: Introduction to part modeling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model ***(Minimum 24 machine components need to be developed)***

Part Modeling & Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

MACHINE DESIGN-II

BT-622 ME-VI SEM MM: 100

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. **6**

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. **4**

Unit-III

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. **4**

UNIT IV

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,

6

UNIT V

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

6

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

DYNAMICS OF MACHINES

BT-623 ME-VI SEM MM: 100

Unit I

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. Turning moment 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. **7**

Unit II

Gyroscope:

Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopicstabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

4

Mech. Vibrations:

Types of Vibration, Degrees of freedom. Longitudinal Vibration: Single degree free and damped vibration. Forced vibration of single degree under harmonic excitation. Vibration isolation.Whirling of shaft and critical speed. **5**

Unit III

Balancing: Introduction,static balance, dynamic balance, balancing of rotating masses,two plane balancing, graphical and analytical methods, balancing of reciprocating masses,balancing of single cylinder engine, balancing of multi cylinder inline engines. **8**

Unit IV

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, Controlling force diagrams for Porter governor and spring controlled governors. **8**

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

8

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.

REFRIGERATION & AIR CONDITIONING

BT-621 ME-VI SEM MM: 100

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). **8**

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. **8**

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. Thre fluid system. **5**

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 **3**

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. **9**

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. **7**

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
6. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai
7. Thermal Environment Engg. byKuhen, Ramsey &Thelked.

MECHATRONICS

BT-624 ME-VI SEM MM: 100

Unit 1

Introduction, synergy of systems, definition of mechatronics, applications of mechatronics in design and modeling, actuators and sensors, intelligent controls, robotics, manufacturing etc., objectives, advantages and disadvantages of mechatronics, examples of mechatronics systems in industry.

Mechanical components in mechatronics, force, friction and lubrication, materials, mechanical behavior of materials, mechanisms used in mechatronics, lever and four bar mechanisms, bearing, belt, chain, cam, slider crank, clutches etc. **8**

Unit II

Electronics elements in mechatronics, conductors, insulators and semi conductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semi conductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter.

Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter, digital computer, microprocessor and its architecture, micro-controllers, programming logic controllers, their basic structures, mnemonics. **8**

Unit III

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first and second order systems to a step input, frequency response analysis, automatic control systems, digital control systems.

Motion control devices, actuator types & application areas, hydraulic and pneumatic actuators, electrical actuators, DC servomotor, AC servomotor and stepper servomotor, micro-actuators, drive selection and applications. **8**

Unit IV

Sensors and transducers, their static and dynamic performance characteristics, internal sensors, external sensors and micro-sensors, sensors for displacement, position and proximity; velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors, selection of Sensors.

Stages in designing mechatronics systems, traditional and mechatronic design, possible design solutions, case studies of mechatronics systems, pick and place robot, automatic car park systems, engine management systems etc. **8**

Unit V

Mechatronics in industry, autotronics, bionics and avionics and their various applications, mechatronics in manufacturing, features of mechatronics in manufacturing, flexible manufacturing systems, manufacturing automatic protocol, computer integrated manufacturing, just in time production systems, CNC machines, adaptive control machine system, CNC machine operations, challenges in mechatronics production units. **8**

BOOKS & REFERENCES:

1. A Kuttan, “Introduction to Mechatronics, Oxford University Press, 2010.
2. Alciatore&Histand, “Introduction to Mechatronics & Measurement Systems, 4e”, McGraw-Hill Education, 2014.
3. M Jouaneh, “Fundamentals of Mechatronics”, Cengage Learning, 2013.
4. W. Bolton, “Mechatronics”, Pearson Education, Second Edition, 1999.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.

6. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
7. NitaigourPremchandMahadik, “Mechatronics”, McGraw-Hill Education, 2015.
8. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics”, Prentice – Hall of India Pvt., Ltd., 2000.
9. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. “Mechatronics: Integrated Mechanical Electronic Systems”, Wiley

FLUID MACHINERY

BT-620 **ME-VI SEM** **MM: 50**

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 & *c*urve),Classification of turbines, Impulse turbines, Constructional details, Velocity triangles,Power and efficiency calculations, Governing of Pelton wheel

8

UNIT-II

Reaction Turbines:

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power andefficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principlesof similarity, Unit and specific speed, Performance characteristics, Selection of waterturbines.

8

UNIT-III

Centrifugal Pumps:

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

8

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.

Hydraulic ram, Jet pumps, Air lift pumps.

8

BOOKS:

1. Hydraulic Machines by JagdishLal, 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

BT-670 ME-VI SEM MM: 50

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

MACHINE DESIGN-II Lab

BT-672 **ME-VI SEM** **MM: 50**

A. Computer and Language :students are required to learn the basics of computer language such as C and 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 computer programand validate it for the design of machine components done in theory subject (*5practical turns*)

C. Mini Project: Each **s**tudent will be given a real life problem for the complete design of a subsystem/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.

THEORY OF MACHINES LAB

BT-673 **ME-VI SEM** **MM: 50**

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

REFRIGERATION & AIR CONDITIONING Lab

BT-671 **ME-VI SEM** **MM: 50**

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.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency , PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

ADVANCED WELDING TECHNOLOGY

BT-821 **ME-VIII SEM** **MM: 100**

UNIT-I

Introduction: Welding as compared with other fabrication processes,Importance and application of welding, classification of welding processes, Health & safety measures in welding. **3**

Welding Power Sources: Physics of welding Arc**,** Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. **3**

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes. **3**

UNIT-II

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.

UNIT-III

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention. **5**

UNIT-IV

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding. **2**

Weld ability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminium. Micro & Macro structures in welding. **4**

UNIT-V

Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record. **5**

Books and References:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
4. Welding Handbooks (Vol. I & II).

PLANT LAYOUT AND MATERIAL HANDLING

BT-822 **ME-VIII SEM** **MM: 100**

UNIT-II

Criteria, Strategies/Tactics, Sustainability and Eco-Efficiency in Facility Design, Basic Planning, Alternative Machine Arrangements, Flow Lines, Location Models, Act/Building Details, Aisles and Security, Storage, Shipping and Receiving, Offices, Specialized Areas. **8**

UNIT -II

Workstations, Unit Loads & Containers, Conveyors, Vehicles, Lifting Devices, Workstation Material Handling, Ethics in Facility Design

Facilities design procedure and planning strategies, Production, activity and materials flow analysis, Space requirements and personnel services design considerations. **8**

UNIT -III

Layout construction techniques: systematic layout planning; activity relationship analysis, pair wise exchange, graph-based construction algorithmic.

Material Handling: Material handling principles; material handling equipment and material handling systems. **8**

UNIT -IV

Computerized Layout and Analytical Methods: ALDEP, CORELAP, CRAFT, BLOCPLAN, etc.

Warehouse operations: function, storage operations.

Manufacturing operation: JIT, TQM, AM, CIM, SCM, Facility systems,

Quantitative models: Layout model, waiting line, AS/RS, simulation model, etc. **8**

UNIT –V

Assessment and evaluation of layout alternatives Projects, Use Spiral software to practice plant layout design, Apply mathematical and engineering techniques such as systematic layout planning approach, quantitative model, cost estimate to solve practical facility layout problem. **8**

Books and References:

1. Plant Layout and Material Handling, by- James M. Apple, John Wiley & Sons.
2. Plant Layout and Material Handling, by- Fred E. Meyers, Prentice Hall.
3. Facility Layout and Location: An Analytical Approach, by Richard L, Francis, Pearson India.
4. Plant Layout and Material Handling, by- B. K. Aggarwal, Jain Brothers.
5. Plant Layout and Material Handling, by- S. C. Sharma, Jain Brothers.
6. Materials Handling Handbook, by- Raymond A. Kulwiec, John Wiley & Sons.
7. Plant Design and Economics, by- Peters, McGraw Hill Education.
8. Purchasing and Material Management, by- Gopalakrishnan, McGraw Hill Education.

QUALITY CONTROL

BT-824 **ME-VIII SEM** **MM: 100**

UNIT-I

Introduction : Concept and evaluation of quality control. Measurement & Metrology, precision vs accuracy. Process capability, standrdisation & Interchangeability. **3**

Inspection and Gauges : Inspection methods. Types of Gauges. Limits Fits and Tolerances. Non-Destructive Testings & Evaluation. **5**

UNIT-II

Control Charts for SQC : Statistical Quality Control (SQC). Control charts for variables such as X, R charts and control charts for attributes such as p-chart, c-chart. Construction & use of the control charts. Process capability. **8**

UNIT-III

Acceptance Sampling for SQC : Principle of acceptance sampling. Producer's and consumer's risk. Sampling plans – single, double & sequential. Sampling by attributes and variables. **7**

UNIT-IV

Reliability : Introduction to reliability, bath-tub curve. Life expectancy. Reliability based design. Series & Parallel System. **3**

Defect Diagnosis and prevention : Basic causes of failure, curve/control of failure.
MTBF. Maintainability, Condition monitoring and dignostic techniques. **4**
Value Engineering : Elements of value analysis, Techniques. **2**

Unit-V :

TQM : Basic Concept, Quality control , Quality Assurance and Quality Management and Total Quality Management. Implementation of TQM . ISO 9000 and its series, Zero defect. . Taguchi method, Six Sigma concepts. **6**

Other Factors in Quality : Human Factors such as attitude and errors. Material-Quality, Quality circles, Quality in sales & service. **2**

Books and Reference:

1. Statistical Quality Control by Grant and Leavarworth, McGraw Hill
2. Maintenance for Reliability by Rao.

NON-CONVENTIONAL ENERGY RESOURCES

BT-801 ME-VIII SEM MM: 100

UNIT-I

Introduction

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. **3**

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations. **4**

UNIT-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **9**

UNIT-III Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. **4**

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. **2**

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. **3**

UNIT-IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **2**

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems. **6**

UNIT-V

Bio-mass: Availability of bio-mass and its conversion theory. **2**

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants. **3**

Text/References Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning