OPJS UNIVERSITY, CHURU
B. Tech. Mechanical

III Semester

3ME1A: MECHANICS OF SOLIDS-I
(Common With Aeronautical 3AN1, Prod; Ind. En. 3PI1A, Automobile En. 3AE1A)
Max. Marks: 100

Exam Hrs: 3

UNIT 1

Simple Stress and Strain: Tension, compression, shearing stress and strain, Linear elasticity, Poisson's ratio, Hooke's law for linear elastic isotropic material, Equations of static equilibrium, Concept of free body diagram, Composite bars, Thermal stresses, Stresses on inclined planes, Generalised Hooke's law for 2D and 3D cases, Strain Energy in axial loads, Stress-strain curves: Behavior of common materials in simple tension and compression test, Concept of factor of safety and permissible stress, Introduction to plasticity, viscoelasticity, anisotropy and orthotropy.

UNIT 2

Principal Stress and Strain: Combined loading, Plane stress and Plane strain, Stress and strain Transformation, Principal stress and maximum shear stress, and their planes, Concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. Theories of Elastic Failures: The necessity for a theory, Different theories and their applications.

UNIT 3

Members Subjected to Flexural Loads: Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams, Moving loads, Relation between load, shear force and bending moment.

UNIT 4

Bending and Shear Stresses in Beam: Bending formula, Section modulus, Distribution of bending stresses. Transverse shear stress and its distribution in circular, hollow circular, rectangular, Box, I, wide flange, T sections etc. Strain energy in bending, Combined axial and lateral loads. Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels.

UNIT 5

Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity, Strain energy in torsion, Stresses in members subjected to combined axial, bending and torsional loads.

Columns and struts: Equilibrium, buckling and stability, Short, long and intermediate columns, Euler's formula for crippling load for columns, different end conditions, equivalent length, Eccentric loading Rankine formula and other empirical relations.

Suggested Readings
1. James M. Gere, Mechanics of Materials, Cengage Learning (Brooks\Cole).
2. Pytel and Kiusalaas, Mechanics of Material,Thomson (Brooks\Cole).
3. Crandall, Dahl and Lardner, An Introduction to the Mechanics of Solids, Tata McGraw Hill.
4. Beer, Johnston, Dewolf and Mazurek, Mechanics of Materials, Tata McGraw Hill.
5. Ryder G.H.,Strength of Materials, Macmillan India.
6. Sadhu Singh, Strength of Materials, Khanna Publishers.
7. Punmia, Jain and Jain, Mechanics of Material, Laxmi Publications.

3ME2A: MATERIAL SCIENCE AND ENGINEERING

(Common with Prod. & Indl. Engg. 3PI2A, Automobile Engg. 3AE2A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Crystal structure – BCC, FCC and HCP, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Frank Reed source of dislocation, Elastic & plastic modes of deformation, Bauschinger's effect, slip & twinning, strain hardening, seasons cracking, cold/hot working recovery, re-crystallization and grain growth, strengthening of metals.

Constitution of alloys: Solid solutions - substitutional and interstitial. Phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. Iron – Iron carbide equilibrium diagram. Classification of steel and cast iron, microstructure, properties and application.

UNIT 2

Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel. Gray, White, malleable, spheroidal -Graphite – alloy cast-iron. Copper and Copper alloys – Brass, Bronze and Cupronickel. Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys.

UNIT 3

Heat Treatment- Definition – Full annealing, stress relief, spheroidizing – normalising, hardening and tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate, Hardenability, Jominey end quench test
– Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding
– Flame and Induction hardening.

UNIT 4

Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes.

Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test.

UNIT 5

Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ etc. Fibre and particulate reinforced composites and resin plastics.

Introduction to Nano materials- Nano structured materials, Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters & Nano crystals. Electronic and optical properties of nano crystallites, Metallic and semiconducting super lattices. Synthesis of nanostructured materials,

Suggested Readings

1. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials Prentice-Hall of India
2. William D Callister, Material Science and Engineering, John Wiley and Sons.
3. Raghavan.V. Materials Science and Engineering, Prentice Hall of India.
4. Avner, S. H. Introduction to physical metallurgy: Tata McGraw-Hill.
5. Jacobs, J. A., & Kilduff, T. F. Engineering materials technology: structures, processing, properties, and selection, Pearson/Prentice Hall.
6. Koch, C. C. Nanostructured materials: processing, properties, and applications: William Andrew Pub.
7. Kodgire V.D. and Kodgire S.V., Material Science and Metallurgy for Engineers, Everest Publishing House, Pune, 2008.
8. John V.B., Introduction to Engineering Materials, ELBS, 6th edition, 2001
9. Reed-Hill T.E. and Abbaschian R., Physical Metallurgy Principles, Thomson, 2003
10. William F. Smith, Material Science and Engineering, McGraw Hill Education (India)

3ME3A: ENGINEERING THERMODYNAMICS

(Common Prod. & Indl. Engg. 3PI3A, Automobile Engg. 3AE3A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Basic Concepts of Thermodynamics: Thermodynamics system, control volume, properties, state, processes and cycle, equality of temperature, zeroth law of thermodynamics, temperature scale, laws of perfect gas, pure substances, vapour-Liquid–solid-phase equilibrium in a pure substances, thermodynamic surfaces. Work and Heat: Law of conservation of mass and energy, first law of thermodynamics, steady state processes.

UNIT 2

Second law of thermodynamics, heat engine, Carnot cycle, Kelvin Planck and Clausius Statement Equivalence of Kelvin Plancks and Clausius statements Carnot theorem, thermodynamic temperature scale, Clausius inequality, entropy, change of entropy for

different processes. Available and Unavailable Energy: Availability of a non flow and steady flow system, Helmholtz and Gibb's functions.

UNIT 3

Thermodynamic Relations, Important mathematical relations, Maxwell relations, Tds Relations, Joule-Thomson coefficient, Clayperon equation. Behaviour of real gases, equation of state, vander Waal equation, critical points, reduced coordinates, generalised compressibility chart.

UNIT 4

Air–Standard Power Cycle: Brayton cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies. Reciprocating air compressor: Working, Efficiency, multistage compression, condition for minimum work, Intercooler.

UNIT 5

Properties of Steam: Phase change process, use of steam table and mollier chart. Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating properties of ideal working fluid in vapour power cycle co-generation cycle.

Suggested Readings
1. Chattopadhyay P., Engineering Thermodynamics, Oxford University Press.
2. Nag P.K., Engineering Thermodynamics, Tata Mc-Graw Hill
3. Van G.J. Wylen and Sonntag R.E., Fundamental of Thermodynamics, John Wiley &Sons
4. Cengel Y.A. and. Boles M.A, Thermodynamics-An Engineering Approach, McGraw Hill
5. Jones J.B.&.Dugan R.E, Engineering Thermodynamics, Prentice Hall of India.
6. Rao Y.V.C., An Introduction to Thermodynamics, Wiley Eastern Ltd.
7. Ballaney P. L., Thermal Engineering, Khanna Publisher.
8. Moran M.J and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley and Sons
9. Rogers, Gorden., Engineering Thermodynamics, Pearson Education.

3ME4A: MANUFACTURING PROCESSES
(Common With Automobile Engg. 3AE4A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

General Classification and Introduction to Manufacturing processes.

Foundry Technology: Casting: Definition and major classification; Casting materials, Sand mould casting: Patterns: types, material and design including pattern allowances. Moulding sands; composition, preparation, properties and testing; Grain fineness; moisture content, clay content and permeability test. Core & core prints; Gating system:

types, pouring basin, sprue, runner and risers; Foundry equipment and furnaces. Melting, pouring and solidification. Principles and method of floor mould casting, shell mould casting, pit mould and loam mould casting; CO_2 mould casting; centrifugal casting, investment casting; Permanent mould casting. Die casting; Slush casting; Casting defects; types, causes and remedy

UNIT 2

Forming Processes: Classification; Hot working and cold working; principle, advantages, disadvantages and applications. Forging: Classification; work materials different forging operations, tools and equipment ; Smithy, drop forging and press forging methods and use; Forging dies; types, materials and design. Rolling: Characteristics and applications of hot rolling and cold rolling; Roll pass design. Extrusion; Work materials and products; Press tool works; Basic principles, system, operations and applications. Shearing; Parting, notching, trimming, nibbling, blanking and piercing, Drawing: wire drawing, tube drawing and deep drawing. Design of blanks for any shearing and drawing operation. Estimation of forces and power required for shearing and drawing operations. Spinning, flow turning, Bulging, Coining and embossing; basic principle and methods. metal working defects, cold heading, riveting, thread rolling bending and forming operation.

UNIT 3

Metal Joining Processes: Welding, Brazing and soldering, Adhesive bonding, Fusion welding: - Principle, characteristics and applications of gas welding, thermit welding, electrical arc welding; Submerged arc welding; TIG and MIG welding; Induction welding; Plasma arc welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding. Laser beam welding and electron beam welding.

Solid state welding process; Principles, process details of Forge welding; Friction welding; Diffusion welding; Ultrasonic welding. Pressure welding; Explosive welding. Welding defects; Types, causes, effects and remedy. Electrodes and Electrode Coatings

UNIT 4

Powder Metallurgy: Properties of Powder processed materials, Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of Powder metallurgy.

Rapid Prototyping Operations: Introduction, subtractive processes, additive processes, Virtual Prototyping and applications

UNIT 5

Plastic Technology: Classification of Plastics, Ingredients of Moulding compounds, General Properties of Plastics, Plastic part manufacturing processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slush moulding, laminating.

Suggested Readings

1. Rao.P.N., Manufacturing Technology, Vol 1,2 and 3, Tata McGraw Hill
2. Ghosh, A., & Mallik, A. K. 1986. Manufacturing Science: Ellis Horwood.
3. Schey, Introduction to Manufacturing Processes, Tata McGraw Hill
4. Kalpakjian, S., & Schmid, S. R., Manufacturing processes for engineering materials, Pearson Education.
5. Campbell, J. S. Principles of manufacturing materials and processes: Tata McGraw-Hill

6. Heine, R.W., Loper, C.R., and Rosenthal, P.C., "Principles of Metal casting", Tata McGraw Hill.

7. Groover, M.P., Fundamentals of Modern Manufacturing: Materials, Processes and systems, Prentice Hall, New Jersey

8. Kalpakjian, S. & Schmid S.R, Manufacturing Engineering and Technology, Addison Wesley Longman

9. Little, R.L., Welding and welding technology Tata McGraw-Hill Education

10. Shan, H.S., Manufacturing Process, Pearson Education.

3ME5A: OBJECT ORIENTED PROGRAMMING IN C ++
(Common with Aeronautical3AN5, Automobile Engg. 3AE5A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Introduction to Object Oriented Programming: Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.

UNIT 2

Basics of C++ Environment: Variables; Operators; Functions; user defined, passing by reference, passing an array to the function, inline function, scope, overloading; Pointers: objects and lvalue, arrays and pointers, the new and delete operators, dynamic arrays, arrays of pointers and pointers to arrays, pointers to pointers and functions; Strings: String I/O, character functions in ctype.h, string functions in string.h.

UNIT3

Object oriented concepts using C++: Classes: Member functions, Friend functions, Constructors, Access functions, Private member functions, class destructor, static data and function members; Overloading: inline functions, this operator, overloading various types of operators, conversion operators; the String Class; Composition and Inheritance: Hierarchy and types of inheritance, protected class members, private versus protected access, virtual functions and polymorphism, virtual destructors, abstract base classes.

UNIT 4

Templates and Iterators: function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers, string streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library.

UNIT 5

Data Structures Using C++: Linked lists – Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.

Suggested Readings

1. Balaguruswamy E.: Object Oriented Programming in C++ , McGraw Hill Education (India)

2. Sahay: OBJECT ORIENTED PROGRAMMING WITH C++ , Oxford

3. Hubbard, John., Programming with C++ , McGraw Hill Education (India)
4. Rambaugh James etal, "Object Oriented Design and Modelling", PHI.
5. Budd, Timothy, "An Introduction to Object Oriented Programming", Pearson Education.
6. Venugopal, K.R., Mastering C++, McGraw Hill Education (India)
7. Ravichandra, D., Programming with C++, McGraw Hill Education (India)

3ME6A: ADVANCED ENGINEERING MATHEMATICS
(Common with Prod. & Indl. Engg. 3PI6A, Automobile Engg. 3AE6A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Fourier transform: Discrete and Fast Fourier transform, Complex form of Fourier transform and its inverse, Fourier sine and cosine transform and their inversion. Properties of F-transform, Convolution theorem for F-transform, Parse Val's identity of for F-transforms Applications of Fourier transform for the solution of partial differential equations having constant coefficients with special reference to heat equation and wave equation.

UNIT 2

Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and integration of transforms, Applications to differential equations.

UNIT 3

Statistical Techniques: Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions, Moments, Moment generating functions, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non –linear.

UNIT 4

Numerical Analysis: Finite differences, Difference operators, forward, Backward, central & average operators. Newton's forward and backward interpolation formula, Stirling's central difference formula Lagrange's interpolation formula for unequal interval. Solution of non linear equations in one variable by Newton Raphson's and Regula falsi's method .

UNIT 5

Numerical solution of simultaneous algebric equation by Gauss elimination and Gauss seidel method. Numerical differentiation, Numerical integration trapezoidal rule, Simpson's one third and three eight rule. Numerical solution of ordinary differential equation of first order: Picards method, Euler's, and modified Euler's,method, Milne's methods and Runga Kutta fourth order method.

Suggested Readings

1. Chandrika Prasad, Mathematics for Engineers, Prasad Mudralaya

2. Jeffrey, Advanced Engineering Mathematics , ELSEVIER
3. Chandrika Prasad , Advanced Mathematics for Engineers, Prasad Mudralaya
4. Grewal B. S., Higher engineering Mathematics, Khanna Publication, New Delhi
5. Keyszig E., Advanced Engineering Mathematics, Wiley Eastern Publication
6. Peter V. O. Neil, Advanced Engineering mathematics, Thomson Publication
7. Gerald, C.F., and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley.
8. Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern.
9. Kandasamy, P., Thilagavathy, K., and Gunavathy, S., Numerical Methods, S Chand and Company.
10. J. Douglas Faires, Richard L. Burden, Numerical Methods, Cengage Learning.

3ME7A: MATERIAL SCIENCE AND TESTING LAB
Max. Marks: 75
Exam Hrs: 3

Material Science (Perform any 7-experiments)

1. Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids.
2. Material identification of, say, 50 common items kept in a box.
3. Study of brittle and ductile fracture.
4. Specimen preparation for metallographic examination /micro structural examination-cutting, grinding, polishing, etching.
5. Grain Size determination of a given specimen.
6. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
7. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
8. Annealing of Steel -Effect of annealing temperatures and time on hardness.
9. Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
10. Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.
11. Study the effect of Carbon percentage on the hardness of Steel.

Material testing (Perform any 5-experiments)

1. To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading
2. To determine Rockwell/ Vickers/Brinell hardness of a given material
3. To perform Column test of a given material and to determine its Euler's buckling

load and Young's modulus of elasticity

4. To perform Impact test on a given material and to determine its resilience.

5. To study and perform Fatigue test on a given material and to determine fatigue strength of the material

6. To perform test on closed and open coiled helical springs under axial loading on spring tester and to determine modulus of rigidity of the spring material

7. To perform various wood tests on given wooden specimens on Universal Wood testing machine and to determine various strengths and properties of the wood.

8. To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.

9. To perform a testing of strain hardened specimen and to determine effect of strain hardening on various material properties.

10. To perform a testing of hardness of the specimen on computerized micro-hardness tester.

11. Creep testing on creep testing machine

12. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

Suggested Readings

1. Vander Voort, Metallography: Principles and Practice, McGraw-Hill, 1984
2. Prabhudev K.H., Handbook of Heat Treatment of Steels, Tata McGraw-Hill, 2000.
3. Suryanarayanan, A.V.K. "Testing of Metalic materials" TataMcGraw Hill,1993

3ME8A: BASIC MECHANICAL ENGINEERING LAB
Max. Marks: 75
Exam Hrs: 3

Exposure to a wide range of applications of mechanical engineering through a variety of activities, including hands-on assembly and disassembly of machines, such as, bicycle, sewing machine, pumps, engines, air-conditioners, machine-tools, amongst others; observational study of complex systems via cut sections, visits, videos and computer simulations; design of simple machines/systems including specifications formulation; visits to industries.

Note: Student will be required to submit written report indicating the learning achieved by Hands on assembly/Disassembly.

3ME9A: PRODUCTION PRACTICE-I

Max. Marks: 75
Exam Hrs: 3

Machine Shop

1. To study lathe machine construction and various parts including

attachments, lathe tools cutting speed, feed and depth of cut.

2. Exercise on lathe involving machining of work piece within specified tolerance involving step turning, taper turning, knurling, chamfering, thread cutting and other lathe operations
3. To perform taper turning by tailstock offset method as per drawing.
4. To cut metric thread on lathe machine as per drawing.
5. To perform square threading, drilling on lathe machine as per drawing.
6. To study shaper machine, shaper tools and prepare job on shaper machine.

Foundry Shop

1. To prepare mould of a given pattern requiring core and cast it in Aluminium.
2. To perform moisture test and clay content test.
3. Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and hardness Test (Mould and Core).
4. To perform permeability test.
5. A.F.S. Sieve analysis test.

Welding Shop

1. Hands-on practice on metal inert gas welding (MIG) or gas metal arc *welding.*
2. Hands-on practice on tungsten inert gas welding (TIG) or gas tungsten arc welding.
3. Hands-on practice on spot welding.
4. Hands-on practice on submerged arc welding

3ME10A: COMPUTER PROGRAMMING LAB
Max. Marks: 50
Exam Hrs: 3

List of Programs in C++

1. Program using basic I/O and control statements.
2. Program using class, objects, objects as function parameters.
3. Program using functions and passing reference to a function, inline functions. Program using
4. Inheritance and virtual base class.
5. Program using pointers, arrays, dynamic arrays. Program using functions defined in ctype.h and string.h.
6. Program using constructors, destructors. Program using function and operator over Loading

List of program in C++ implementing Data Structures.

7. Creating and managing (add, delete, print, insert) nodes of a Linked list.
8. Creating and managing (create, pop, push etc.) stacks and queues.

Note: Students should submit and present a minor project at the end of the lab.

3ME11A: MECHANICAL ENGINEERING DRAWING

Max. Marks: 75
Exam Hrs: 3

Review of sectioning, Review of BIS Standard (SP 46), Fasteners – screws, bolts and nuts, riveted joints, pins, locking devices, welded joints, pipe joints, unions and valves. Assemblies involving machine elements like shafts, couplings, bearing, pulleys, gears, belts, brackets. Tool drawings including jigs and fixtures. Engine mechanisms-assembly and disassembly. Production drawings - limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Layout drawings. Schematics, process and instrumentiation diagrams, piping drawings. Structural drawings - examples for reading and interpretation. Computer aided design and use of software packages for engineering drawings.

Assembly Drawing with sectioning and bill of materials

Universal Coupling, Forming punch and die, Jigs for inspecting shaft etc.(1 drawing sheet of any assembly)

Lathe tail stock, shaper tool head, steam stop valve, feed check-valve, swivel machine vice etc (1 drawing sheet of any assembly)

Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes (1 drawing sheet)
Check-valve, Junction Valve etc.

Computer Aided Drafting (4 drawings)

Introduction, input, output devices, introduction to software like AutoCAD/ProE/ Creo/Solidworks, basic commands and development of 2D and 3D drawings of simple parts **Free Hand Sketches**: Connecting rod, crank shaft, Pipes and Pipe fittings, machine arbor and cutter, universal dividing head, jigs and fixtures, Step less drive, sliding gear box, safety valve, three way stop valve, blow-off cock, Swivel bearing, Turret Tool Post, drill-press vice, screw jack

Suggested Readings

1. Laxminarayan and M.L. Mathur,Machine Drawing ,Jain Brothers
2. Engineering Drawing by Parkinson
3. Bhatt ND, Machine Drawing,
4. Gill P S, Machine Drawing, Kataria & Sons
5. Basudeb Bhattacharya, Machine Drawing, Oxford University Press
6. Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company, 1996.
7. Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS, 1995.
8. Siddeshswar N., P Kannaiah, VVS Shastry, Machine Drawing,Tata McGraw Hill
9. Engineering drawing Practice for School and Colleges, SP46-1988 (BIS)

IV SEMESTER

4ME1A: KINEMATICS OF MACHINES
(Common With Automobile Engg. 4AE1A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Kinematics: Elements, pairs , mechanisms, four bar chain and its inversions, velocity and acceleration, Klein's construction, coriolis component, instantaneous center method,

UNIT 2

Synthesis of mechanisms, panto graph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms. Automotive vehicle mechanisms: Overhead valve mechanism, Davis and Ackerman steering mechanism, Trifler suspension and Hookes joint.

UNIT 3

Power transmission: Belts and ropes, effect of centrifugal force, creep, chain drive. Friction: Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, pivots and friction axis, bearing, Theory of film lubrication.

UNIT 4

Clutches, Brakes and dynamometers: Band, block and band & block brakes, braking action, absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers braking system of automobiles.

UNIT 5

Cams: Type of cams, displacement, velocity and acceleration curves for different cam followers, consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.

Suggested Readings

1. Mallik, A. K., Ghosh, A., & Dittrich, G. Kinematic analysis and synthesis of mechanisms: CRC Press.
2. Uicker, J. J., Pennock, G. R., & Shigley, J. E. Theory of machines and mechanisms, Oxford University Press
3. Robert L. Norton, Kinematics and Dynamics of Machinery, McGraw Hill Education (India)
4. S. S. Rattan, Theory of Machine, ed. 3, McGraw Hill Education (India)
5. Rao, J. S. The Theory Of Machines Through Solved Problems: New Age International.
6. Ballaney PL, Theory of Machines and Mechanisms, Khanna Publications.
7. Bevan, Thomas. The theory of machines, Pearson Education
8. Vinogradov, O. G. Fundamentals of kinematics and dynamics of machines and mechanisms, CRC Press.

4ME2A: FLUID MECHANICS
(Common With Automobile Engg. 4AE2A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Basic Concepts and Properties- Fluid – definition, distinction between solid and fluid Modules and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension. Fluid statics concept of fluid static pressure, absolute and gauge pressures – pressure measurements by manometers and pressure gauges. Hydrostatic forces on submerged surfaces, centre of pressure, Stability of floating bodies.

UNIT 2

Fluid Kinematics and Fluid Dynamics- Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline Bernoulli's equation, applications-Venturi meter, Orifice meter, Pitot tube. Orifices, mouthpieces, Notches and Weirs, Momentum theorem.

UNIT 3

Dimensional Analysis: Buckingham variables, Model Similitude, Force ratio, Reynolds, Froude's, Mach, Weber and Euler numbers and their applications. Undistorted model distorted model scale effect.

Incompressible Fluid Flow- Viscous flow - Navier - Stoke's equation (Statement only) Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes. (Hagen Poiseulle's equation).

UNIT 4

Turbulent Flow: Variation of friction factor with Reynold's number Moody's diagram, Shear stress in turbulent flow, Prandt Mixing length theory , velocity distribution in smooth pipes and rough pipes, Resistance of smooth and rough pipe.

Flow Through Pipes: Minor and major losses, Darcy-Weisbach Formula, , Hydraulic and Energy Grade lines, Flow through pipes in series and in parallel, power transmission, water hammer in pipes.

UNIT 5

The Boundary Layer: Description of the boundary layer. Boundary Layer thickness, Von-Karman momentum integral equation, Coefficient of drag, boundary layer separation and control.

Flow around a body, Drag and lift, Drag on sphere and cylinder, Development of lift on a circular cylinder, Development of lift on an airfoil.

Suggested Readings

1. Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata McGrawHill
2. Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata McGraw Hill
3. Robert W. Fox and Alan T. McDonald, Introduction to Fluid Mechanics, John Wiley

&Sons.

4. Potter, Mechanics of Fluids, Cengage Learning.
5. Frank M. White, Fluid Mechanics, Tata McGraw Hill.
6. John F. Douglas, Fluid Mechanics, Pearson Education.
7. Modi and Seth, Fluid Mechanics and Hydraulic Machinery, Standard Book House.
8. Som, S. K., & Biswas, G. Introduction to fluid mechanics and fluid machines: Tata McGraw-Hill.
9. Munson, B. R., Young, D. F., & Okiishi, T. H. Fundamentals of Fluid Mechanics, Wiley

4ME3A: MACHINING AND MACHINE TOOLS
(Common with Automobile Engg. 4AE3A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Classification of metal removal process and machines: Concept of generatrix and directrix Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS, NRS and interrelationship. Concept of orthogonal and oblique cutting. Mechanism of Chip Formation: Type of chips, chip breakers. Mechanics of metal cutting, interrelationships between cutting force, shear angle relationship. Cutting strain, cutting strain rate. Various theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting. Introduction to tool geometry of milling cutters and drills.

UNIT 2

Concept of machinability, machinability index, factors affecting machinability, Tool Wear, Tool Life and Tool Material- Different mechanism of tool wear.Types of tool wear (crater, flank etc), Measurement and control of tool wear, Concept of tool life, Taylor s tool life equation (including modified version). Different tool materials and applications including effect of tool coating. Machining Time- Estimation of machining time in different machining operations, Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods

UNIT 3

Basic machine tools: Constructional configuration and specifications of lathe, drilling machine, shaping machine, milling machine, grinding machine. Broaching operation

Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines. Swiss automatic, operational planning and turret tool layout, sequence of operations. Tracer attachment in Machine Tools

UNIT 4

Introduction to Grinding-Need and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications , mounting and dressing. Surface finishing: Honing, lapping, superfinishing, polishing and buffing processes.

Thread Manufacturing: casting; thread chasing; thread cutting on lathe; thread rolling, die threading and tapping; thread milling and thread grinding.

UNIT 5

Gear Manufacturing Processes: hot rolling; stamping; powder metallurgy; extruding etc. Gear generating processes: gear hobbling, gear shaping. Gear finishing processes: shaving, grinding, lapping, shot blasting, phosphate coating, Gear testing.

High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming. Industrial Safety: precautions to be taken by operators for safe working on different machine tools.

Suggested Readings

1. Lal G.K.,Introduction to Machining Science, New Age international Publishers.
2. Ghosh, A., & Mallik, A. K. , Manufacturing Science, East West Press Private Limited.
3. Pandey & Singh, Production Engineering Science, Standard Publishers Distributer, Delhi.
4. Karl H.Heller, All About Machine Tools, Wiley Eastern Ltd., New Delhi
5. Sen, G. C., & Bhattacharyya, A. Principles of Machine Tools: New Central Book Agency
6. Bhattacharyya A, Theory & Practice of Metal Cutting, New Central Book Agency
7. Boothroyd, G., & Knight, W. A. Fundamentals of machining and machine tools: Taylor and Francis.
8. Trent, E. M. Metal cutting: Butterworth Heinemann
9. Stephenson, D. A., & Agapiou, J. S. Metal cutting theory and practice: CRC Taylor & Francis.
10. Kalpakjian, S., & Schmid, S. R. Manufacturing Engineering and Technology, Addison Wesley Pub. Co.
11. Milton C. Shaw, Metal Cutting Principles, CBS Publishers.

4ME4A: DESIGN OF MACHINE ELEMENTS – I
(Common With Automobile Engg. 4AE4A, Prod. & Indl. Engg 4PI4A)
Max. Marks: 100
Exam Hrs: 3

UNIT 1

Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects. Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.

UNIT 2

Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration, causes and mitigation, fatigue failures, Design of machine elements subjected to direct stress, pin, cotter and keyed joints,

UNIT 3

Design of Members in Bending: Beams, levers and laminated springs.

UNIT 4

Shaft, Keys and Couplings: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys. Design of muff coupling, flanged couplings: rigid and flexible

UNIT 5

Threaded fasteners, Forms of threads, Locking devices, Terminology, Bolted joints, Bolt of uniform strength, Preloading of bolts, Eccentric loading, Brackets.

Suggested Readings

1. Bahl and Goel, Mechanical Machine Design, Standard Publishers Distributors.
2. Bhandari, V. B., Introduction to Machine Design, McGraw Hill Education (India)
3. Shigley, Joseph E., Mechanical Engineering Design, McGraw Hill Education (India)
4. Sharma and Aggarwal, Machine Design, S.K.Kataria and Sons, Delhi.
5. Sharma and Purohit, Design of Machine Elements, Prentice Hall India.
6. Kulkarni S. G., Machine Design, Tata McGraw Hill
7. Karwa A., A Text Book of Machine Design, Laxmi Publications.
8. Hall A.S., A.R. Holowenko and H.G. Langhlin, "Theory and Problems of Machine Design, Schaum's Outline Series, McGraw Hill
9. Spotts M.F., Design of Machine Elements, Pearson Education
10. Juvinall R.C. and K.M. Marshek, Fundamental of machine component design , John Wiley & Sons

4ME5A: INDUSTRIAL ENGINEERING

(Common With Automobile Engg. 4AE5A)

Max. Marks: 100
Exam Hrs: 3

UNIT 1

Concept and definition of Industrial Engineering, Historical development of IE, Role of Industrial Engineer, Applications of IE

Concept of Productivity, Work Study and Productivity, Techniques of work study, basic procedure, approach to method study, method study charts and diagrams, principles of motion economy, Work measurement; basic procedure, techniques: Stop watch time study and work sampling, rating, determination of standard time.

UNIT 2

Evolution of Management Theory, scientific management, Contributions of Taylor, Fayol, Mayo to scientific management, Levels of Management Administration and Management, fundamental functions of management, Decision making.

Business Forms and Organization: Forms of Business: Single proprietorship, partnership, joint stock company, co-operative society, State undertakings. Formation of Joint Stock Companies: Registration, issue of Prospectus, Commencement Certificate. Organization: meaning, Types of organization; Line, Functional, Line Staff organization and line Staff Committee organization, span of control.

UNIT 3

Finance & Financial Statements: Introduction, Needs of Finance, Kinds of Capital, Sources of fixed capital, Shares. Borrow capital, surplus profits. Sources of working capital and its management, Profit & Loss Statement, Balance Sheet, Financial ratios: Liquidity ratio, Profits investment ratio, equity ratio, inventory ratio.

UNIT4

Time value of money: Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal life, comparison of deferred investments, Future worth comparison, payback period comparison. Rate of return, internal rate of return, comparison of IRR with other methods.

UNIT 5

Depreciation: Causes, Basic methods of computing depreciation charges; Straight line, Sinking fund, Declining Balance and Sum of year's digits method. Breakeven analysis: Basic concepts, Linear Breakeven analysis for single product, Breakeven charts, Dumping.

Suggested Readings

1. Prasad, L.M., Principles and practice of Management, Sultan Chand & Sons.
   2. Sushil Kumar Basu, K. C. Sahu, N. K. Datta, Works Organisation & Management, Oxford & IBH.
3. Dexter S. Kimball, Principles of Industrial Organization, Read Books.
   4. Leon Pratt Alford, Henry Russell Beatty, Principles of Industrial Management, Revised Edition, Ronald Press Co.
   5. Essentials of Industrial Management, McGraw-Hill Industrial organization and management series, Lawrence L. Bethel, McGraw-Hill.
6. Riggs, J.L., Bedworth, D.J., Randhawa, S.U., Engineering Economics, Tata McGraw-Hill.

4ME6A: I.C. ENGINES

(Common With Automobile Engg. 4AE6A)

Max. Marks: 100
Exam Hrs: 3

UNIT 1

History of IC engines: Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles.

Testing & Performance: Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.

UNIT 2

Fuel & Combustion: Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.

Fuel: Conventional Petroleum, structure, Refining Fuels for SI & CI engines, Knock rating, Additives, Fuels for Turbine & Jet Propulsion.

Alternative Fuels: Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.

UNIT 3

Engine Systems & Components: Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburettors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations.

CI engine: Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors.

Ignition system: Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.

UNIT 4

Engine Friction & Lubrication : Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.

Supercharging: Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.

UNIT 5

Dual & Multi fuel engines: Principle, fuels, Combustion, performance Advantages, Modification in fuel system.
Special Engines: Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.

Suggested Readings

1. Gupta H.N., Fundamentals of Internal Combustion Engines, Prentice Hall of India
2. Mathur & Sharma, Internal Combustion Engines, Dhanpat Rai & Sons
3. Edward Obert F., Internal Combustion Engines, Harper and Raw Publisher.
4. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill

Education.

5. Lichty, Internal Combustion Engines, McGraw Hill.
6. Gill, Smith, Ziurs, Fundamentals of Internal Combustion Engine, Oxford & IBH Publishing
7. Rogowsky, IC Engines, International Book Co.
8. Ganeshan, V., Internal Combustion Engine, McGraw Hill Education (India)
9. Yadav R., I.C Engine, Central Publishing House

4ME7A: KINEMATICS OF MACHINES LAB

Max. Marks: 75

Exam Hrs: 3

1. To study inversions of four bar chain: Coupling Rod, Beam Engine
2. To study Steering Mechanisms; Davis and Ackerman.
3. Study of quick return mechanism and draw velocity and acceleration diagram.
4. Study of inversion of Double slider chain Oldham Coupling, Scotch Yoke and Elliptical Trammel.
5. Study of various cam-follower arrangements.
6. To plot displacement v/s angle of rotation curve for various cams
7. To determine co-efficient of friction using two roller oscillating arrangement.
8. Study of various types of dynamometers, Brakes and Clutches.
9. To determine moment of inertia of the given object using of Trifler suspension.

4ME8A: FLUID MECHANICS LAB

Max. Marks: 50

Exam Hrs: 3

1. Determination of Metacentric height of a given body.
2. Determination of C_d, C_v & C_c for given orifice.
3. Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate.
4. Determination of velocity of water by Pitot tube.
5. Verification of Bernoulli's theorem.
6. Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter
7. Determination of head loss in given length of pipe.
8. Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
9. Determination of Coefficient for minor losses in pipes.
10. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
11. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Suggested Readings

1. Desmukh T. S., Fluid Mechanics and Hydraulic Machines A Lab Manual.

4ME9A: PRODUCTION PRACTICE-II
Max. Marks: 75
Exam Hrs: 3
Perform any seven Experiments.

1. To study of single point cutting tool geometry and to grind the tool as per given tool geometry.
2. To study the milling machine, milling cutters, indexing heads and indexing methods and to cut teeth of spur gears on milling machine.
3. To machine a hexagonal / octagonal nut using indexing head on milling machine.
4. To cut BSW/Metric internal threads on lathe machine.
5. To cut multi-start Square/Metric threads on lathe machine.
6. To prepare the job by eccentric turning on lathe machine using four jaw chuck.
7. Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
8. Exercise on milling machine for generation of plane surfaces and use of end milling cutters.
9. Grinding of milling cutters and drills.
10. Exercise on cylindrical and surface grinding on grinding machine as per drawing.
11. Boring using a boring bar in a centre lathe.
12. Cylindrical grinding using grinding attachment in a centre lathe.

4ME10A: MACHINE DESIGN SESSIONAL-I
B. Tech. Mechanical 4th Semester   **Max. Marks: 75**
0L+0T+3P   **Exam Hrs: 3**

1. Material selection and relevant BIS nomenclature
2. Selecting fit and assigning tolerances
3. Examples of Production considerations.
4. Problems on:
   (a) Knuckle & Cotter joints
   (b) Torque: Keyed joints and shaft couplings
   (c) Design of screw fastening
   (d) Bending: Beams, Levers etc.
   (e) Combined stresses: Shafts, brackets, eccentric loading.
   (f) Design for rigidity (Transverse/Torsional)

Suggested Readings

1. Design Data Book, PSG College of Technology

4ME11A: THERMAL ENGINEERING LAB
Max. Marks: 75
Exam Hrs: 3

1. Study and comparison of 2 stroke and 4 stroke IC engines (cut models) and performance parameters..
2. Study and comparison of SI and CI Engines (Cut Models).
3. To draw valve timing diagram for a single cylinder diesel engine.
4. To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power.
5. To prepare heat balance sheet of a four stroke diesel engine.
6. To perform constant speed load test on computerised test rig and to plot performance curves along with pressure-theta diagram.
7. Morse Test: To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine.
8. Study of fire tube boilers-its mountings and accessories.
9. Study of water tube boiler-its mountings and accessories.
10. Study of two stage reciprocating compressor.
11. Term work on survey of commercial two wheelers and four wheelers including compilation of technical specifications and presentation.