SEMESTER 3

12M301 COMPLEX VARIABLES AND TRANSFORMS 3 2 0 4

COMPLEX VARIABLES: Complex differentiation: Analytic function, Cauchy Riemann equations, harmonic functions (8+4)

Complex integration: Cauchy's integral theorem, Cauchy's integral formula, Taylor and Maclaurin series, Laurent series (concepts and statements only),singularities and zeros, residue integration method, residue integration of real integrals. conformal mapping, geometry of analytic functions, linear fractional transformations, conformal mapping of exponential, trigonometric, hyperbolic functions. (14+11)

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting , transforms of derivatives and integrals, unit step function, t- shifting , dirac's delta function , periodic functions , convolution , differentiation and integration of transforms, method of solving differential equations and integral equations by using Laplace transform technique. (12+8)

FOURIER TRANSFORM: Fourier integral, Fourier transform, Fourier cosine and sine transform, Discrete Fourier transform , Fast Fourier transform – DIT algorithm (11+7)

Total L:45+T:30=75

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics",John Wiley &Sons, New Delhi, 2011.
2. Ray Wylie C and Louis C Barret, "Advanced Engineering Mathematics", Tata McGraw- Hill, New Delhi, 2004.

REFERENCES

1. John H.Mathews and Russell W.Howell, "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 2006.
2. Riley K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering", Cambridge University, Cambridge, 2002.

12M302 FLUID MECHANICS 3 1 0 3.5

INTRODUCTION: Properties of fluids. Concept of gauge and absolute pressures, measurement of pressure using manometers of different types. Types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Stream line, streak line and path line. (5+2)

IDEAL FLOW: Ir-rotational and rotational, stream function, potential function, continuity equation, derivation of three dimensional equation, applications to one dimensional flows, differential momentum equation, Impact of jets-force on fixed and moving vanes, flat and curved. (7+2)

FLUID DYNAMICS: Navier Stokes equation – derivation and problems , derivation of Euler's equation and Bernoulli's energy equation, examples illustrating the use of energy equations. (5+2)

FLOW MEASUREMENT: Orifice meter, venturi meter, flow nozzle, Pitot tubes, multi-hole probe and anemometer, Rotameter, hotwire anemometer, Magnetic flow meter, Dislplacement meter, Current meter (5+2)

LAMINAR FLOW: Hagen-Poiseuille equation – velocity profile, power calculations. Laminar flow between parallel plates - Couette flow and Plane Poiseuille flow. (5+1)

FLOW THROUGH CIRCULAR PIPES: Pipes in series and parallel. Reynolds number, Darcy-Weisbach equation, use of Moody diagram, minor losses-sudden expansion, sudden contraction and losses in pipe fittings. (6+2)

BOUNDARY LAYER THEORY: D'Alembert paradox, Development of boundary layer, Prandtl's boundary layer equations, Blasius solution, integral momentum equation, drag on a flat plate, boundary layer separation and its control, streamlined and bluff bodies - flow around circular bodies and aero foils, calculation of lift and drag, Prandtl's Mixing length theory. (6+2)

DIMENSIONAL ANALYSIS AND MODEL TESTING: Buckingham's π theorem, Reynolds, Froude and Mach number and their application in model testing. (4+2)

INTRODUCTION TO CFD: Necessity, limitations, philosophy behind CFD, applications. (2+0)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Munson B R, Young D F and Okiishi T H, "Fundamentals of Fluid Mechanics", John Wiley & Sons., Singapore, 2006
2. Kumar D S, "Fluid Mechanics and Fluid Power Engineering", Kataria S K and Sons, New Delhi, 2010.

REFERENCES:
1. Frank M White, "Fluid Mechanics", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011
2. Victor Streeter, E. Benjamin Wylie, K. W. Bedford, "Fluid Mechanics", Tata McGraw Hill, New Delhi, 2011.
3. Kumar K L, "Engineering Fluid Mechanics", Eurasia Publications Limited, New Delhi, 1990.
4. John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 1995.
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/FLUID-MECHANICS/ui/TOC.htm
6. www.freestudy.co.uk

12M303 MECHANICS OF MATERIALS 3 1 0 3.5

STRESSES AND STRAINS: Stress and strain due to axial force, elastic limit, Hooke's law-factor of safety - stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature. Strain Energy due to axial force- proof resilience, stresses due to gradual load, sudden load and impact load. (7+2)

CHANGES IN DIMENSIONS AND VOLUME: Lateral strain - Poisson's ratio, volumetric strain, changes in dimensions and volume, shear stress, shear strain, relationship between elastic constants. Hoop and Longitudinal stresses in thin cylindrical and spherical shells under internal pressure-changes in dimensions and volume, study of boiler cylinders and end covers. (7+3)

BENDING MOMENT AND SHEAR FORCE: Relationship between load, shear force and bending moment - shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments, maximum bending moment and point of contra flexure. (7+2)

FLEXURE IN BEAMS: Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to flexure. (6+2)

TORSION: Theory of torsion and assumptions-derivation of the equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, close coiled helical spring with axial load. (6+2)

PRINCIPAL STRESSES AND STRAINS: (Two dimensional only) State of stress at a point - normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method, application to simple problems, Strain Rosettes. (6+2)

DEFLECTION OF DETERMINATE BEAMS: Governing differential equation - Macaulay's method-moment area method, application to simple problems; Bending moment and shear force diagram of a typical shaft, elastic instability, Euler Formula. (6+2)

Total = L: 45 + T: 15= 60

TEXT BOOKS:
1. Punmia B C, Ashok Kumar Jain and Arun Kumar Jain, "Mechanics of materials", Laxmi Publications, New Delhi, 2005.
2. Egor Paul Popov, Toader A. Balan, "Engineering Mechanics of Solids ", Prentice Hall Inc., 1998

REFERENCES:
1. Ramamrutham S and Narayan R, "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 2008
2. Jindal U C, "Textbook on Strength of Materials", Asian Books Pvt. Ltd., 2007.
3. Don H Morris, William F Riley and Leroy D Sturges, "Mechanics of Materials", John Wiley and Sons Inc., 2006.
4. Lord Chilver and John Case, "Strength of Materials and Structures", Arnold, 1999.
5. http://nptel.iitm.ac.in/syllabus/112104036/

12M304 MANUFACTURING PROCESSES II 3 0 0 3

THEORY OF METAL CUTTING : Introduction, Nomenclature of a single point cutting tool, mechanics of metal cutting, orthogonal and oblique cutting, Mechanism of chip formation, Types of chips Use of chip breaker in machining, Machining forces and Merchant's Circle Diagram (MCD), **Cutting Force Measurements:** Forces developing and acting in machine tools. Analytical and Experimental determination of cutting forces, Dynamometers for measuring cutting forces, Cutting temperature, cutting fluid application, Concept of Machinability , Failure of cutting tools and tool life, Cutting Tool Materials. (7)

MACHINE TOOLS: General Purpose Machine Tools lathes, milling machines- types**,** Construction and Operation. Construction, working principle and applications of shaping, planing and slotting machines. Methods of mounting of jobs and cutting tools in machine tools, Use of various Attachments in Machine Tools. (8)

HOLE MAKING OPERATIONS: Drilling machines and its operations, Reaming, Boring, Tapping and other Hole Making Operations-Simple work holding devices-Concept of Jigs and Fixtures and its applications (3)

SURFACE FINISHING PROCESSES: Purpose and application of grinding, Selection of wheels and their conditioning, Grinding Process Parameters, Honing, Lapping and super finishing, (5)

MACHINE TOOL TESTING: Introduction, Measuring instruments used for testing, Test Procedures, Acceptance tests, Alignment tests-Spindle alignment, Positioning error compensation modeling – displacement, squareness and straightness, angular, Positioning error measurement using laser interferometer - direct indirect measurement. (4)

SCREW THREADS AND GEAR MANUFACTURING METHODS: Production of screw threads by Machining, Rolling and Grinding, Manufacture of Gears. (7)

ESTIMATION OF MACHINING TIME: Calculation of machining time & cost estimation for turning, drilling, milling and shaping. General principles of economics of machining. Economic tool life, optimal cutting speed for total minimum cost, and estimation of machine hour rate and machining cost computations. (6)

NON - TRADITIONAL MACHINING Need for Non Traditional Machining, Abrasive Jet Machining, Ultrasonic Machining (USM), Water Jet Machining, Electro Chemical Machining- Electrical Discharge Machining, Electron Beam Machining and Laser Beam Machining, Equipment, Process, Process Parameters and Machining Characteristics, Modelling of material removal, Material Removal Rate (MRR) calculation, Applications, Limitations. (5)

Total = L: 45 = 45

TEXT BOOKS:

1. P N Rao, "Manufacuring Technology – Metal Cutting & Machine Tools", Tata McGraw-Hill Publishing Company Limited, 2001
2. Milton C Shaw, "Metal Cutting Principles", Clarendon Press, Oxford, 1999.

REFERENCES:

1. Kalpakjian," Manufacturing Engineering and Technology", Addison Wesley Publishing Company Inc.,2001.
2. http://nptel.iitm.ac.in/video.php?subjectId=112105126
3. Chapman.W, Workshop Technology Part-2, Taylor & Francis,1972
4. James Brown, "Advanced Machining Technology Handbook", McGraw Hill Book Company, New York, 1998.
5. Edward M Trent, Paul K Wright, "Metal Cutting", Butterworth, 2006.
6. Anne Marie Habraken, "Material Forming Processes", ISTE, 2007.

12M305 KINEMATICS OF MACHINERY 3 1 0 3.5

BASICS OF MECHANISMS: Terminology and definitions, degree of freedom, mobility. Grashoff's law. Kinematic inversions - 4-bar chain, slider crank chain. Mechanical advantage. Transmission angle. Description of common mechanisms, applications of mechanisms. (6+2)

KINEMATICS: Displacement, velocity and acceleration analysis in simple mechanisms, graphical method, velocity and acceleration polygons. Kinematic analysis by algebraic method, a demonstration, vector approach, Chace equation, computer applications in the kinematics analysis of simple mechanisms. (9+3)

FRICTION DRIVES: Limiting ratio of belt/rope tensions, centrifugal tensions. Condition for maximum power transmission, corresponding speed in belt and rope drives, Estimation of frictional power in pivots and collar bearings, power screws - calculation of power. (6+2)

KINEMATICS OF CAM: Classifications, displacement diagrams-parabolic, uniform velocity, simple harmonic paths. Layout of plate cam profiles for different types of followers - knife - edged, roller, mushroom, flat type, the fundamentals of cam design, derivatives of follower motion, sizing of cam -pressure angle, transmission angle, radius of curvature for different types of followers and undercutting. (6+2)

GEARS: Spur gear terminology and definitions. Fundamental law of toothed gearing and tooth forms. Interchangeable gears, gear tooth action-interference and undercutting. Helical, bevel, worm, rack and pinion gears (basics only). Gear trains, epicyclic gear trains, differentials, automotive transmission gear trains. (8+2)

GYROSCOPIC COUPLE: Gyroscopic couple and its effect in ship, car, motorcycle, aircraft and space vehicles, gyroscopic stabilization. (5+2)

SYNTHESIS OF LINKAGES: Number and dimensional synthesis – two position synthesis of slider crank and four bar- mechanisms. Introduction of commercial software packages for the development of kinematic models – velocity analysis – acceleration analysis. (5+2)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Shigley J E and Uicker J J, "Theory of Machines and Mechanisms", McGraw -Hill Inc., New Delhi, 2003.
2. Rattan S S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 2009.

REFERENCES:

1. Beven T, "Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.
2. Ghosh and Mallick, "Theory of Mechanisms and Machines" Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao J S and Dukkipati, "Mechanism and Machine Theory", Wiley- Eastern Ltd., New Delhi, 1992.

4. Ashok G. Ambedkar “Mechanism and Machine Theory”, PHI Learning Private Limited, New Delhi, 2009.
5. Waldron K J and Kinzel G L, “Kinematics, Dynamics And Design Of Machinery - (Cd - 5650)”, John-Wiley and Sons Inc., 2004.
6. http://utubersity.com/?page_id=1023

12M306 ENGINEERING THERMODYNAMICS 3 1 0 3.5

BASIC CONCEPTS OF THERMODYNAMICS: Introduction, System, property, Concepts of pressure and temperature and temperature scales, Measurement of pressure and Temperature International Temperature Scale, Zeroth law of thermodynamics and application (3+1)

PROPERTIES OF PURE SUBSTANCES, IDEAL GASES AND PROPERTIES OF STEAM: Ideal gas equation, compressibility, universal compressibility chart, Pure Substances, PVT Surfaces, PV, TV, and PT diagrams of water and other substances and differences of the same, phase-change processes, Concept of Vapor Pressure, Properties of steam, Saturation Temperature and Pressure, Use of property tables. (3+1)

BASIC THERMODYNAMIC PROCESSES: Thermodynamics state and equilibrium, process and cycle, work, heat and other forms of energy. Evaluation of Work for various thermodynamic processes, Concept of a heat engine and cyclic machines. (3+2)

FIRST LAW OF THERMODYNAMICS: First law of thermodynamics, applications to closed and open systems, uniform and non-uniform processes, steady state and unsteady state processes, general energy equation and applications to thermal equipment. (5+2)

SECOND LAW OF THERMODYNAMICS: Kelvin-Planck and Clausius statements**-**heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem, Thermodynamic temperature scale, Deduction of the third law of thermodynamics , Types of Irreversibility. (5+2)

ENTROPY: Clausius theorem, Property of Entropy, Clausius inequality, Entropy Principle, Applications of entropy principle, Maximum work obtainable from finite heat reservoirs, Entropy Generation in Closed and Open Systems, Isentropic Work in a Steady Flow Open System (6+2)

AVAILABLE ENERGY, AVAILABILITY AND IRREVERSIBILITY: Basics, Available energy referred to a cycle, Maximum work in a reversible process, Reversible work-open cycle and closed system, Gibbs and Helmholtz Functions, Availability and Irreversibility, Second law efficiency (4+1)

ADVANCED PROPERTIES OF SUBSTANCES AND THERMODYNAMIC RELATIONS: TS diagrams, Mollier Chart , Properties of Ideal Gases, Equations of State, Law of Corresponding States, Properties of Mixtures, Thermodynamic Relations, Maxwell’s Equations, Joule Kelvin Effect, Clausius-Clapeyron Equation, Conditions of Thermodynamic Equilibrium and Stability and Gibbs Phase Rule. (6+1)

VAPOR POWER CYCLES: Steam Power Cycle, Rankine Cycle, Actual Vapor Cycle, Reheat cycle, Regenerative cycle, Binary vapor cycle, Characteristics of an ideal working fluid in Vapor Power Cycle, (6+2)

INTRODUCTION TO IC ENGINE CYCLES: Basic working of an Internal Combustion Engine, Air standard cycles Otto cycle, Diesel cycle (4+1)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Sonntag R E, Borgnakke C and Van Wylen G J,“Fundamentals of Engineering Thermodynamics”, John Wiley, 2003
2. Nag P K, “Engineering Thermodynamics”, Tata McGraw Hill, Delhi, 2004.

REFERENCES:

1. Cengel Y Al and Boles M A "Thermodynamics, An Engineering Approach” Tata McGraw Hill, 2003.
2. Michael J Moran, “Fundamentals of Engineering Thermodynamics”, Wiley India Pvt. Ltd., 2010.
3. Holman J P, “Thermodynamics”, Tata McGraw Hill, 1998.
4. http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Basic%20Thermodynamics/New_index1.html

12M310 MACHINE DRAWING 2 0 3 3.5

INTRODUCTION: Introduction to machine drawing. Review of orthographic and isometric projections, Importance of sectional views. Computer-aided drafting. (1+6)

CONVENTIONS: Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges. (3+6)

ASSEMBLY CONCEPTS: Methods and concepts of assemblies-assembly requirements, Bill of materials. Methods of assembly-bolts, nuts, studs, screws and pins. Methods of arresting motion of a member in an assembly. Assembly and dismantling exercise of

a typical assembly with emphasis on assembly sequence and appropriate fits. Assembling and dismantling practice in assemblies like pneumatic cylinder, machine vice. (3+9)

FITS AND TOLERANCES: Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols- methods of indicating the surface roughness. Blue print reading exercises. Making blue print drawings of production drawing. (9+12)

ASSEMBLY DRAWING PRACTICE: Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints, C clamp. Free hand sketching of I.C Engine subassemblies like piston and connecting rod, gear box. (8+6)

ASSEMBLY USING SOLID MODELING: Modeling and assembly using a CAD software-extracting views and sections. Drawing of assemblies-plummer block, machine vice, stop valve, screw jack, tail stock, cylindrical gear box, simple drilling. Creation of bill of materials, calculation of mass and section properties, interference check between solids. (6+6)

Total = L: 30 + P: 45 = 75

TEXT BOOKS:

1. Gopalakrishna K R, "Machine Drawing", Subhas Stores, Bangalore, 2003.
2. BIS, SP:46-2003 – "Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.

REFERENCES:

1. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.
2. "CAD/CAM Manual", PSG College of Technology, Coimbatore, 2002.
3. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s. Kalaikathir Publishers, Coimbatore, 2012.
4. ASME Y 14.5M-1994, "Dimensioning and Tolerancing", ASME, New York, 1995.

12M311 MANUFACTURING PROCESS LABORATORY I 0 0 3 1.5

LATHE

1. Study of construction features and manufacturing methods – Head stock, Tail stock, Carriage, Cross slide, Compound rest, Belt, Guide ways, Feed gear box, Apron gear box.
2. Turning - Facing, chamfering and step turning
3. Turning -Taper turning and knurling
4. Turning- Step turning and Grooving
5. Turning –Step turning and Thread cutting-External
6. Turning -Eccentric turning
7. Turning- Facing, Drilling and Boring
8. Turning – Pin and bush assembly for H8 e8 clearance fit
9. Turning- Boring and internal thread cutting
10. Dismantling and assembly of Head and Tail stock

Total = P: 45 = 45

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER 4

12M401 PROBABILITY AND STATISTICS 3 1 0 3.5

PROBABILITY: Introduction, sample space and events, interpretations of probability, addition rule, and conditional probability, multiplication and total probability rules, independence, Baye's Theorem. (4+1)

RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS: Random Variables - Discrete random variables, probability distributions and probability mass functions, cumulative distribution functions ,mean and variance , discrete distributions- Binomial, Poisson and geometric distributions. (6+2)

Continuous random variables – Probability distributions and probability density functions, cumulative distribution functions, mean and variance, continuous distributions – uniform, normal, exponential and Weibull distributions. (6+2)

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete random variables, marginal and conditional probability distributions, independence , two dimensional continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation, simple linear regression by least square method. (8+2)

STATISTICAL INFERENCE: Sampling distribution, law of large numbers, central limit theorem, estimation, point estimates, interval estimates, determination of sample size, maximum likely hood estimation. (5+2)

TESTS OF HYPOTHESIS: Procedure in hypothesis testing , types of errors, p value, large and small sample tests , inference concerning means, variances and proportions - Chi -Square test of independence. (8+2)

ANALYSIS OF VARIANCE: Introduction, assumptions of analysis of variance, completely randomized design, randomized block design. (4+2)

QUALITY CONTROL: Control charts for measurements, control charts for attributes, tolerance limits. (4+2)

Total L:45+T:15=60

TEXT BOOKS:

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers," Wiley India, Delhi, 2012.
2. Richard A. Johnson, "Miller & Freund's, "Probability and Statistics for Engineers", Prentice Hall, New Delhi, 2009.

REFERENCES:

1. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole, USA, 2012.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, New Delhi, 2007.
3. Eugene. L. Grant and Richard .S. Leavenworth, "Statistical Quality Control", Tata McGraw Hill , New Delhi, 2010

12M402 BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING 3 0 0 3

ELECTRIC CIRCUITS : Ohm's law, KCL, KVL, Solving simple DC Circuits - Single phase AC circuit fundamentals – Power, Power factor – solving simple AC circuits – 3 phase AC circuits – Star and Delta Connection. (7)

DC MOTORS: Principle of Operation- types – back emf – torque equation - speed torque characteristics – losses and efficiency – speed control of DC motor – Electric Braking - Applications. (5)

AC MACHINES : 3 phase Induction Motor -construction– Principle of operation – types – torque equation - speed torque characteristics – 1 phase Induction Motor – Principle of operation- types. Synchronous Motors – construction - Principle of Operation. - Electric Braking of Induction Motor – Single phase Transformers – Construction and working principle – Types. (6)

INDUSTRIAL APPLICATIONS: Motor Selection – factors to be considered – power rating – types of Duty cycle – selection of motors for machine tools applications, centrifugal pumps. (3)

ELECTRONIC DEVICES: Operation of PN junction diodes, VI characteristics, zener diode, BJT-types -CB, CE, CC configurations, input and output characteristics, JFET, difference between FET and BJT-working principle and characteristics. MOSFET- types, principle of operation and characteristics, Opto Electronic Devices-Introduction, types, photo conductive, photo diode, phototransistor, Light emitting diode - Principles and Applications. (7)

ELECTRONIC CIRCUITS: (Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC-coupled amplifier, frequency response, oscillator, Barkhausen criteria, RC phase shift oscillator. (5)

LINEAR INTEGRATED CIRCUITS: Operational amplifiers, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector – 555 Timer IC – Astable mode (7)

DIGITAL ELECTRONICS: Number systems- representation of signed numbers: 1's complement and 2's complement, logic gates, Half adder, full adder, parallel adder/subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers. (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Mehta.V.K and Rohit Mehta, "Principles of Electrical Engineering and Electronics", S.Chand & Co. Limited., New Delhi, 2006.
2. Muthusubramanian.R, Salivahanan.S and Muraleedharan.K.A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill Publishers, 2006.

REFERENCES:

1. Pillai.S.K,"A First Course on Electrical Drives", New Age International Publications Limited, 2011.
2. Murugesh Kumar.K, "Basic Electrical Science and Technology", Vikas Publishing Limited, 2011.
3. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", New Age International Limited, 2003
4. Leach.D. P, Malvino.A.P and Goutam Saha, "Digital Principles and Applications", Tata Mc Graw – Hill, 2008

12M403 COMPUTER NUMERICAL CONTROL AND ROBOTICS 3 0 2 4

INTRODUCTION: Objectives of Numerical Control, CNC and DNC machine tools, Adaptive control, Applications. CONSTRUCTION OF MACHINE TOOLS: Constructional features, AC & DC motors, Selection criteria, Speed & Feed control units, Control of translational movements (Slideways and guideways), Control of rotational movements, Tool holders, Tool changing arrangements, work holders, Linking structures. Output Transducers**:** Transducers, Positional transducers, Encoders. (7+5)

NUMERICAL CONTROL OPERATION: Designation of axes on NC machine tools, linear and rotary motions, machine operating systems, Positioning control, linear and contour control. Principles of operation of NC machine tools: Basic principles, closed loop systems, open loop, input signals, methods of input. (7+5)

CNC PROGRAMMING: Design of CNC control panel, Word address programming, Part programming, datum, G-codes, Parts of CNC program, incremental and absolute programming, circular interpolation, Tool length and diameter offset, work holding and tooling for machining centers, programming machining centers. CNC turning tools, presetting tools, machine zero, tool change position, part origin, offsets, machine control, program editing, diagnostics. (6+3)

PROGRAMMING CNC TURNING MACHINES: Planning the program, workholding, tooling considerations, process plan, tool offset, determining the G50 offsets, programming examples. Linear and circular interpolation, Cutter diameter compensation, Do loops and subprograms. Programming CNC turning machines – Diameter Vs radius programming, circular interpolation, a complete lathe example. (6+3)

ADVANCED CNC FEATURES: Macros, Canned cycles, Mirror imaging, Polar rotation, Use of computers in numerical control programming, CIM and the future of numerical control (4+3)

ROBOTICS: Introduction to Robotics. Classification, components of robots, robotic applications. Systems overview of a robot-components of a robot system, and application. Functions of a robot, specifications of a robot system. (7+5)

MECHANICAL SYSTEMS, COMPONENTS DYNAMICS AND MODELING: Manipulator, end effectors, electric actuators. (4+3)

Internal & External State Sensors. Trajectory planning, Forward Position Control, Inverse Problem, Image Processing. Robot Dynamics and Control, Futuristic Topics in Robotics. (4+3)

Total = L: 45 + P: 30 = 75

TEXT BOOKS:

1. Thyer.G.E, “Computer Numerical Control of Machine Tools”, Industrial Press, 1988
2. Stenerson.J, K Curran, “Computer Numerical Control-Operation and programming”, PHI, 2009

REFERENCES:

1. Yoram Koren, “Computer Control of Manufacturing Systems”, Tata McGraw-Hill, 1983
2. “Mechatronics”, HMT limited, 1998
3. Kundra.T.K, Rao.P.N, Tewari.N.K, “Numerical Control and Computer Aided Manufacturing”, Tata McGraw-Hill, 2001.
4. Radhakrishnan.P, “Computer Numerical Control”, New Central Book Agency, 1992
5. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics”, Tata McGraw-Hill, 2008.
6. http://nptel.iitm.ac.in/video.php?subjectId=112101099

12M404 TURBOMACHINERY 3 1 0 3.5

INTRODUCTION: Energy transfer between fluid and a rotor. Euler's energy transfer equation. Components of energy transfer (5+1)

DEGREE OF REACTION: Impulse and reaction type, effect of blade angle on degree of reaction and energy transfer. Specific speed and its significance. (5+2)

HYDRAULIC TURBINE: Impulse type-Pelton wheel. Reaction type-Francis, Kaplan and Propeller. Principles of operation of turbine calculation of main dimensions, regulation and performance. Draft tube-function and types. Cavitation in turbines. (6+2)

PUMPS: Introduction – Differences between positive displacement pump and roto-dynamic pumps. Classification- Radial flow, Axial flow and mixed flow pumps - ideal and actual slip, performance calculation and determination of main dimensions. Minimum starting speed. Cavitation in pumps- Net Positive Suction Head (NPSH). Fluid coupling and torque converter-Efficiency and slip. (5+2)

VACUUM PUMPS: Vacuum – units of vacuum – classification of vacuum pumps – pressure range of vacuum pumps – rotary vane pump – rotating vane pump – roots pump – diffusion pumps – turbo – molecular pump (5+2)

TURBO-COMPRESSORS: Classification. Radial flow- work done by the impeller - isentropic efficiency-pressure and flow coefficients - characteristic curves –surging and choking; Axial flow type- Aerofoil analysis-stalling. Calculation of delivery pressure, isentropic and polytropic efficiency- number of stages. (6+2)

STEAM TURBINES: Types-single stage impulse type - Performance of single stage machine, compounding of turbines-; reaction type, 50% reaction. Flow through Steam nozzles-convergent, convergent-divergent, critical pressure ratio. Meta stable flow. (7+2)

GAS TURBINE: Brayton cycle-Open cycle, closed cycle, methods of improving the efficiency of a simple cycle, multistage compression, inter-cooling, reheating and regeneration, effect of operating variables on thermal efficiency, work ratio. (6+2)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Dixon.S.L, "Fluid Mechanics and Thermodynamics of Turbomachinery", Butterworth-Heinemann, 2010.
2. S.m. yahya "Turbines,compressors and fans"2010.Tata McGraw-Hill Education .

REFERENCES:

1. Yadav.R.Y, "Steam and Gas Turbines", Central Publishing House, Allahabad, 1987.
2. Govinda Rao.N.S, "Fluid Flow Machines", Tata McGraw Hill publishing Company Limited., New Delhi, 1983.
3. Shephered.D.G, "Principles of Turbo Machinery", The Macmillan Co., New York, 1956.
4. Dixon.S.L, "Worked Examples in Turbomachinery", Pergamon Press, New York, 1975.
5. Rao V.V, "Vacuum Science and Technology", Allied Publishers, 2005

12M405 DYNAMICS OF MACHINERY 3 1 0 3.5

STATIC FORCE ANALYSIS OF MECHANISM: Free Body diagram-conditions of equilibrium, two, three and four force members, effect of friction. study of effect of friction. (5+1)

DYNAMIC FORCE ANALYSIS OF MECHANISM: Inertia force and D Alembert‟s principle. Dynamic force analysis of mechanisms including slider crank mechanism. (6+1)

FLYWHEEL: Turning moment diagram-fluctuation of energy and speed, weight of flywheel required. (6+2)

BALANCING: Balancing of revolving, reciprocating masses in single plane and several planes-primary and secondary forces and couples, balancing of multicylinder inline engine. Balancing of V type of engines, direct and reverse crank technique. Balancing machines – field balancing, single and two planes. (7+3)

FREE VIBRATION: Basic features of vibratory systems-elements, degrees of freedom, single degree of freedom system. Undamped free vibration-equation of motion, natural frequency. Damped free vibration, equation of motion, logarithmic decrement, critical speed of shaft. (5+2)

FORCED VIBRATION: Response to periodic forcing-forcing by unbalance, support motion, force and amplitude transmissibility, force transmissibility, vibration isolation, vibration measurement, signature analysis (5+2)

TORSIONAL VIBRATION: Torsional vibration of two and three rotor systems, geared systems, critical speed (5+2)

AUTOMATIC CONTROL OF MECHANICAL SYSTEMS: Open and closed loop systems, block diagram, lag in response, first order system response of linear and torsional systems, second order system response, step displacement input, step velocity input, harmonic input, performance improvement, PID control, transfer function relationships. (6+2)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Shigley.J.E and Uicker.J.J, "Theory of Machines and Mechanisms", McGraw Hill, New Delhi, 2008.
2. Rao.J.S and Dukkipatti.R.V, "Mechanism and Machine Theory", New Age International Limited, New Delhi, 1992.
3. Rattan.S.S, "Theory of Machines", Tata Mc Graw Hill , New Delhi, 2005.

REFERENCES:

1. Bevan.T, "Theory of Machines",CBS Publishers and Distributors, New Delhi, 2002.
2. Ghosh and Mallick.A. K, "Theory of Machines and Mechanisms", Affiliated East West Private Limited New Delhi, 1988.
3. Ballaney.P.L, "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2005.
4. Rao.S.S, "Mechanical Vibrations", Addision Wesley Longman, New Delhi, 1995.
5. Graham Kelly.S, "Fundamentals of Mechanical Vibrations", Mcgraw Hill, Incorporation, 2000.
6. Rao V Dukkipati and Srinivas.J "Textbook of Mechanical Vibrations", Prentice Hall of India, 2005.
7. http://nptel.iitm.ac.in/video.php?subjectId=112104114

12M406 METROLOGY AND INSTRUMENTATION 3 1 0 3.5

BASICS OF MEASUREMENT SYSTEM AND DEVICES: Definition of metrology, economics of measurement, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe's Principle, Principle of interferometry- flatness testing, optical interferometer, laser interferometer. Three stages of generalized measurement system – mechanical loading – static

characteristics of instruments - factors considered in selection of instruments – commonly used terms, error analysis and classification–sources of error – Factors considered in selection of equipment. (8+3)

CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS : Calibration of sensors and measuring instruments – principles of calibration, control of calibration environment, calibration chain and traceability, calibration record, Calibration of Plug gauges, Dial gauges and Instruments-Vernier caliper, Micrometer, surface plates, gauges – feeler gauges,dial indicator, slip gauges, care of gauge blocks Frequency of calibration, General cares and rules in measurement, ISO 9000 quality standards, clean room environment. Line and end measurement – Comparators- mechanical, electrical, optical and pneumatic. (7+2)

GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS: Angular measurement –optical protractors, sine bar, roundness measurement, need for limit gauge, design of plug gauge, Taylor's principle, three basic types of limit gauges, symbols, Tomilson surface meter, CMM – computer controlled CMM, Multi – dimension auto gauging and sorting machine. Types of screw threads, terminology, ISO metric thread, measurement of major, minor and effective diameters, Gear terminology, spur gear measurement, checking of composite errors, base pitch measurement. Study the industrial blue print of the helical gear (6+2)

NON-DESTRUCTIVE TESTING: Methods of Non-Destructive testing, Radiographic inspection, Ultrasonic inspection, Inspection by optical holography. (6+1)

TRANSDUCERS: Displacement transducers – potentiometer, strain gauge –LVDT –inductive sensors, proximity sensors, capacitance transducers, Piezo electric transducer, Hall effect sensor, Integrated circuit sensors, overview of smart sensors. Study the various sensor used in hydraulic and pneumatic system. (5+1)

VIBRATION, TORQUE AND TEMPERATURE MEASUREMENT: Elementary accelerometer and vibrometer – seismic instrument for acceleration – velocity measurement, piezo electric accelerometer, torque measurements, temperature measurement-liquid in glass thermometer, pressure thermometer, resistance temperature detector, thermocouples and thermopiles, thermistor, optical pyrometer – temperature measuring problems in flowing fluid. Study the various types of thermocouple. (7+3)

PRESSURE AND FLOW MEASUREMENT: Elastic transducers– pressure cell, bulk modulus pressure gauge – Low Pressure Measurement: Mc Leod gauge – thermal conductivity gauge, calibration of pressure gauge. Flow measurement – turbine type meter, hotwire anemometer, magnetic flow meter. Study the flow measurement using commercial software. (6+3)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Gupta.I.C, "A text book of Engineering Metrology", Dhanpat Rai publications, New Delhi, 2007.
2. Beckwith.T.G, Roy D. Marangoni, John H. Lienhard, "Mechanical Measurements", Prentice Hall, 2006

REFERENCES:

1. Holmen.J.P, "Experimental Methods for Engineers", Tata McGraw Hill Publications Co Limited, 2004.
2. Narayana.K , "Engineering Metrology", Scitech Publication, 2006.
3. Dominique Placko, "Metrology in Industry: The Key for Quality", ISTE, 2007
4. Jain.R.K, "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
5. Alan S Morris, "Measurement and Instrumentation Principles", Butterworth, 2006.
6. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Mechanical_Measurements_Metrology/index.php.

12M410 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY 0 0 3 1.5

1. Verification of Ohm's law and Kirchoff's laws.
2. Measurement of Power and Power Factor in single phase RLC Circuit.
3. Mechanical Characteristics of DC Shunt and Compound Motor
4. Load test on Three phase Induction Motor
5. Electric Braking of 3 Phase Induction Motor (Dynamic braking / plugging)
6. Study of Halfwave and Fullwave rectifiers with and without filters
7. RC coupled transistor amplifier
8. Applications of Operational Amplifier: Adder, Subractor, Integrator and Differentiator
9. Study of logic gates and implementation of binary adder/subtractor
10. Implementation of Modulo-16 Counter **Total = P: 45 = 45**

REFERENCE:

1. Laboratory Manual Prepared by the Electrical and Electronics Engineering Department.

12M411 FLUID MACHINERY LABORATORY 0 0 3 1.5

1. Flow measurement using mouthpiece and orifice.
2. Calibration and comparison of instruments for measuring flow through pipes-orifice, venturi meter, water meter and rotameter.
3. Calibration and comparison of open channel flow measuring instruments- V-notch and rectangular notch.
4. Experiment on force induced on the vane due to impact of jets.
5. Model study in wind tunnel.
6. Performance test on single stage, multi stage and centrifugal pumps.
7. Load test on impulse water turbine.
8. Load test on reaction water turbine and cross flow turbine.
9. Performance test on axial flow fan.
10. Performance test on centrifugal blower.
11. Stability analysis of floating bodies

Total = P:45 = 45

REFERENCES:

1. Laboratory Manual prepared by Department of Mechanical Engineering.
2. Kumar D S, "Fluid Mechanics and Fluid Power Engineering", Kataria S K and Sons, New Delhi, 2010.

12M412 MANUFACTURING PROCESS LABORATORY II 0 0 3 1.5

Special Purpose Machines

1. Spur gear Milling
2. Spur, helical gear hobbing
3. Shaft grinding, Tool & cutter grinder
4. Plastic Injection Molding
5. Machining with EDM
6. Pocket milling
7. Drilling &force measurement
8. Shaping & slotting
9. Study of various measuring instruments, tools jigs & fixtures
10. Study of super finishing process
11. Exercise on Rapid Prototyping Machine

Total = P: 45 = 45

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER 5

12M501 LINEAR ALGEBRA AND NUMERICAL ANALYSIS 3 0 2 4

VECTOR SPACE: General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space, eigen values and eigen vectors, diagonalization. (12+8)

ERRORS: Computer arithmetic and errors. (2+2)

SYSTEM OF LINEAR EQUATIONS: Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss - Jacobi method,Gauss–Seidel method , convergence criteria. (4+3)

EIGEN VALUES AND EIGEN VECTORS: Power method, QR method. (3+2)

NONLINEAR EQUATIONS:, False position method, Newton's method, convergence criteria, Bairstow's method, Graeffe's root squaring method. (4+3)

INTERPOLATION: Lagrange's polynomial, divided differences, interpolation for evenly spaced data. (5+3)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation evenly spaced and unevenly spaced data,numerical integration, Newton-Cotes formulae, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Gaussian quadratures. (5+3)

ORDINARY DIFFERENTIAL EQUATIONS: Numerical methods for initial value problem, Taylor-series , Euler and Modified Euler method , Runge-Kutta methods, Multi step methods - Milne method, Adams Moulton Method, solution of second order boundary value problem by finite difference method. (10+6)

Total L:45+T:30=75

TEXT BOOKS:
1. Howard Anton and Chirs Rorres " Elementary Linear Algebra Applications Version" Wiley India, New Delhi, 2010."
2. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2011.

REFERENCES:
1. David C.lay, " Linear Algebra and its Applications " Addison –Wesley ,Boston, 2009.
2. Gareth Willams " Linear Algebra with Applications" Narosa Publishing House , New Delhi, 2009
3. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers with Software and Programming Applications", Tata McGraw Hill, New Delhi, 2007
4. Rizwan Butt "Introduction to Numerical Analysis Using Matlab" Infinity Science Press , Hingham, 2008.

12M502 FUNDAMENTALS OF INTERNAL COMBUSTION ENGINES 3 1 0 3.5

THERMODYNAMIC CYCLES: Determination of state's properties, terminologies and cycle efficiencies: Carnot cycle, Air standard cycles- Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, and Dual Cycle. (7+2)

I C ENGINES: Classification. Principle and working of four stroke and two stroke petrol and diesel engines with P-V and valve and port timing diagrams. Comparison of petrol and diesel engines - two stroke and four stroke engines, Wankel engine- rotor and stator geometry, advantages and limitations. (7+3)

FUEL SUPPLY AND IGNITION SYSTEM: Working principles of simple and modern carburetors with modifications for variable speed, load operation. Supercharging and turbo charging. MPFI system. Diesel fuel pumps and injector-working principle- CRDI system. Battery and Magneto ignition type systems. (7+2)

ENGINE LUBRICATION AND COOLING: Necessity of a lubricating system; properties of lubricating oil; Methods and types of lubrication systems; mist, wet sump and dry sump systems; engine performance and lubrication; necessity of engine cooling; disadvantages of over cooling. Cooling systems; air cooling, water cooling: radiators. (6+2)

TESTING AND PERFORMANCE: Testing of IC engines-basics engine measurements: dynamometer; air & fuel flow rate, constant speed and variable speed test, methods of estimating indicated power: Indicator diagram; Willan's line; Morse test, brake power, volumetric efficiency. Heat balance test. (7+3)

COMBUSTION ENGINEERING: Chemical reactions, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion. Normal and abnormal combustion processes –knocking / detonation, Factors affecting knocking/detonation in SI and CI engines; Fuel ratings: Octane and Cetane numbers. (7+2)

ALTERNATE FUELS: Environmental pollution, Environment friendly fuels: bio fuels, Hydrogen fuel cell. (4+1)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:
1. Ganesan.V, "Internal Combustion Engine", Tata McGraw Hill Publishers Co. Limited, New Delhi, 1995.
2. Yunus A Cengel and Michael A Boles, "Thermodynamcis and Engineering Approach", Tata McGraw Hill, New Delhi, 2006.

REFERENCES:
1. Colin R Ferguson, "Internal Combustion Engines", John Wiley and Sons, New York, 1989.
2. Kothandaraman.C.P and Domkundwar.S, "Thermodynamics and Thermal Engineering", Dhanpat Rai and Sons, New Delhi, 2004.
3. Edward F Obert, "Internal Combustion Engines", Interscience Publishers, 1971.
4. Thipse.S.S, "Alternate Fuels-Concepts, Technologies and Develpment", Jaico publishing House, Mumbai, 2010.
5. John B. Heywood, "Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.
6. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Applied_Thermodynamics/index.php

12M503 DESIGN OF MACHINE ELEMENTS 3 1 0 3.5

INTRODUCTION TO DESIGN: Definition, phases in design process, machine element design, preferred numbers, standards and codes in design, criteria for failure, factor of safety. (4+1)

COMBINED STRESSES: Normal stresses, eccentric loading of members, combination of normal and shear stresses, principal stresses, theories of failure. (4+2)

VARIABLE LOADS: Mechanism of fatigue failure, fatigue limit and fatigue strength, S-N curves, types of stress variations, terminology, Soderberg, Goodman and Gerber equations, stress raisers, stress concentration factor, notch sensitivity factor, factors affecting fatigue limit, finite life, equivalent stress, combined variable stress. (5+2)

AN OVERVIEW OF FRACTURE MECHANICS DESIGN: Three modes of crack opening, stress intensity factor, significance of fracture mechanics in design; case studies in failure of components due to crack growth. (3+1)

DESIGN OF SHAFTS AND COUPLINGS: Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Couplings-types and applications, Design of keys-use of standards, rigid couplings, flexible flange couplings – selection, Gear couplings and applications. (5+2)

SPRINGS: Helical springs and leaf springs-stresses and deflection in round wire helical springs-accounting for variable stresses-concentric springs. Design of leaf springs- stress and deflection equation; study of springs used in automobiles, locomotives. (5+2)

RIVETED AND WELDED JOINTS: Strength equations, efficiency, design of riveted joints-joints of uniform strength, eccentrically loaded riveted joints. Types of welded joints-weld symbols, strength of welds, centrally loaded, unsymmetrical sections, axially loaded, eccentrically loaded joints; study of welded/ riveted joints for boilers and tanks. (5+2)

BOLTED JOINTS: I.S.O. Metric screw threads, bolted joints in tension, fluctuating load –torque requirement for tightening; Eccentrically loaded bolted joints. (5+2)

SLIDING CONTACT BEARINGS: Theory of lubrication, hydrodynamic bearings, Sommerfield number, design of hydrodynamic bearings; study of bush bearings of IC engines, Composite dry sliding bearings, bearing housing and mountings. (5+1)

ROLLING CONTACT BEARINGS: Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings, bearing mounting details for machine tool spindles, front and rear axles of automobiles. (4+1)

Total = L: 45 + T:P15 = 60

TEXT BOOKS:

1. Shigley and Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2007.
2. Robert L Nortan, “Machine Design-An Integrated Approach”, Pearson Publishers, New Delhi, 2003.

REFERENCES:

1. Robert L Mott, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London, 1998
2. Faculty of Mechanical Engineering, PSG College of Technology, “Design Data Book", M/s. DPV Printers, Coimbatore, 2010.
3. John M Barson and Stanely T Rolfe, “Fracture and Fatigue Control in Structures”, Prentice-Hall Inc., New Jersey, 1999.
4. Jacobson B O, Bernard J Hamrock and Steven R Schmid, “Fundamentals of Machine Elements ”, Mc Graw Hill, Inc., 2006.
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/New_index1.html

12M504 THERMAL ENGINEERING 3 1 0 3.5

RECIPROCATING COMPRESSOR: Working principle-effect of clearance on volumetric efficiency, equations for shaft work and efficiencies, Multi-Stage Compression, inter-cooler, optimum intermediate pressure in a two stage compressor, performance of multi-stage compressor (7+3)

ROTARY COMPRESSORS: Rotary positive displacement compressor- types-Roots Blower, Sliding Vane Compressor, Performance calculations. Screw Compressor. (6+2)

REFRIGERATION: Methods of refrigeration, Bell Coleman cycle, air refrigeration, vapour compression refrigeration-Reversed Brayton cycle, use of T-s and p-h diagrams, under-cooling and superheating. Performance calculations of air and vapour compression refrigeration systems. Study of Vapour absorption refrigeration system and comparison of various refrigeration cycles. Refrigerants- types, designation and properties, working of Steam Jet Refrigeration (7+3)

PSYCHROMETRY: Atmospheric air-Properties, Psychrometry Chart, Psychrometric processes. (6+3)

AIR-CONDITIONING: Air-conditioning processes, Requirements for comfort and industrial air-conditioning, air washer, By-pass factor, summer and winter air conditioning systems, apparatus dew point, sensible heat factor. (7+2)

GAS DYNAMICS: Mach number- Isentropic Flow, variation of fluid velocity with area, Shocks- normal and oblique, Fanno and Rayleigh flows. (6+1)

JET PROPULSION: Turbo propeller and Turbojet-thrust, thrust power, propulsive power, fuel power, propulsive efficiency, thermal efficiency and overall efficiency. Thrust augmentation. (6+1)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Sarao.A.S, “Thermal Engineering” , Satyaprakasan, New Delhi, 1976
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.

REFERENCES:

1. Arora.C.P, “Refrigeration and Airconditioning”, Tata McGraw Hills, New Delhi, 1992.
2. Kothandaraman.C.P and Domkundwar S, "Thermodynamics and Thermal Engineering", DhanpatRai and Sons, New Delhi, 2004.
3. Rajput.R.K, “Thermal Engineering”, Laxmi Publications (P) Limited, New Delhi, 2009.

4. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/New_index1.html
5. http://nptel.iitm.ac.in/courses.php?disciplineId=112 - Gas Dynamics and Jet Propulsion

12M505 TOOL DESIGN 3 1 0 3.5

CUTTING TOOLS: Materials-properties, classification, selection, insert and coated tools, tool wear, tool life. Recent developments and applications. (4+2)

SINGLE POINT TOOLS: Nomenclature, types and styles, design and manufacture of HSS and carbide insert type tools for turning, boring, shaping, planning and slotting operations. Design of form tools. Tools and holders for CNC applications, tools for dry machining. (6+2)

MULTIPOINT CUTTERS: Nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, taps, dies, thread chasers, milling cutters, broaches, hobs and gear shaper cutters. Grinding-wheel specification and selection (6+2)

JIGS: Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing, elements of jigs, classification of jigs, design of jigs for drilling and reaming. (6+2)

FIXTURES: Principles of fixture design, locators and different types of clamps, elements of fixtures, provision for tool setting, design of fixtures for milling, turning, boring and grinding operations. Fixtures for turning centers and machining centers. Modular fixturing-concepts and applications (6+2)

PRESS TOOLS: Design of sheet metal parts, Design and manufacture of die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operations. Study and selection of press tool for industrial sheet metacomponent. (6+2)

DESIGN OF INJECTION MOULDING AND DIE CASTING DIES: Product and mould, thermal considerations, design of two plate mould, runner and gate design, mould cooling and ejection. Analysis of temperature,viscocity and flow pattern of plastic molten metal using appropriate software. (5+2)

SPECIAL TOOLS: Design of limit gauges. Study of Tool holder maintenance and ATC used in CNC Machining centre. (6+1)

Total = L: 45 + P: 15 = 60

TEXT BOOKS:
1. Arshinov.V and Alekseev.G, "Metal cutting Theory and Cutting Tool Design", MIR Publishers, Moscow, 1976.
2. Donaldson.C and LeCain.C.H, "Tool Design", Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.

REFERENCES:
1. Bhattacharyya.A, “Metal Cutting Theory and Practice”, New Central Books Agency (P) Limited, Calcutta, 2000.
2. Rodin.P, "Design and Production of Metal cutting Tools", MIR Publishers, Moscow, 1968.
3. Kempster, "Introduction to Jig and Tool Design", VIVA Books, New Delhi, 1998.
4. SME, "Manufacturing Engineers Hand Book", 1998.
5. Cracknell.P.C and Dyson.R.W, “Handbook of Thermoplastics Injection Mould Design”, Chapman and Hall, 1993.
6. Paquin.J.R and Crowley, “Die Design Fundamentals”, Industrial Press, NY, 2006

12M506 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY: Environment - Definition, scope and importance – Forest resources: Use and overexploitation, Water resources: Use and over-utilization, dams-benefits and problems – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.– Land resources: land degradation – Role of an individual in conservation of natural resources (6)

WASTE WATER TREATMENT: BOD- definition, basics, effects on water quality, pollution of streams and lakes- waste water treatment: objectives, sources of waste water, septic tanks and waste water treatment plants- Sewage Treatment: sewage characteristics, physical process, microbial process, eutrophication, physicochemical process, activated sludge and anaerobic digestion of sludge- case studies (4)

CORROSION ENGINEERING: Basic Principles, forms of corrosion, corrosion testing, corrosion prevention and typical corrosion case studies in fossil fuel power plants, automotive industry, chemical processing industries, petroleum production operations and refining, corrosion of pipelines. (4)

EARTH’S CLIMATE SYSTEM: Introduction-Climate in the spotlight - The Earth’s Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle. (3)

IMPACTS OF CLIMATE CHANGE: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes. Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes. (3)

CLEAN DEVELOPMENT MECHANISM: CDM and its economic viability for renewable energy projects – advantages for developing countries – emission and efficiency scenario of different energy sources for power generation. Baseline Study – methodology – boundary conditions – base line Fixing – typical case studies. (3)

SOLID WASTE, ENERGY GENERATION AND DISPOSAL: Definition - types – sources – generation and estimation. Properties: physical, chemical and biological – regulation. Energy generation: Basics, types, working and typical conversion efficiencies of composting – anaerobic digestion – RDF – combustion – incineration – gasification – pyrolysis**.** Disposal of wastes**:** Onsite handling, storage and processing – types of waste collection mechanisms - Landfill – classification – site selection parameters (6)

ENVIRONMENTAL ANALYTICAL TECHNIQUES: Objectives of monitoring-Monitoring net work, Planning, system design- Sampling devices, preservation, Classification of analytical methods– Selection of a suitable method - Reliability of analytical data-Statistical analysis- Quality control and assurance. (6)

ENVIRONMENTAL CONSCIOUS MECHANICAL DESIGN: Design for Environment (DFE), Sustainable Product Design, life cycle design, Reuse and Recycling Technologies, Material Selection for Green Design, Six-Sigma implementation in Environmental Conscious Design (5)

GREEN DESIGN: Reuse and recycling technologies, material selection for green design, six-sigma and total quality management implementation in environmental conscious design (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Deswal.S and Deswal.A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004
2. Denny A. Jones, "Principles and Prevention of Corrosion", Prentice Hall, USA, 1996.

REFERENCES:

1. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003
2. Tchobanoglous, Theisen and Vigil, "Integrated Solid Waste Management", McGraw-Hill, New York, 1993.
3. Roger Reeve, "Introduction to Environmental Analysis", John Wiley & Sons Ltd, 2002
4. Kurian Joseph and Nagendran.R, "Essentials of Environmental Studies", Pearson Education Pvt ltd., 2004
5. Myer Kurtz, "Environmentally Conscious Mechanical Design", John Wiley & Sons Ltd,2007
6. Metcalf and Eddy, "Wastewater engineering: Treatment, Disposal and Reuse", McGraw-Hill, 1991.

12M510 MATERIAL SCIENCE AND MECHANICS OF MATERIALS LABORATORY 0 0 3 1.5

1. a. Study of Metallurgical Microscope
   b. Specimen preparation for metallographic studies
2. Study of Grey cast iron, SG iron and Malleable cast iron
3. Study of low, medium and high carbon steel
4. Study of hardened steel and case carburized steel
5. Study of Al and Cu alloys
6. Tension test on metals-stress strain characteristics, ductility, resilience, toughness
7. Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests
8. Impact test on metals-Charpy, Izod impact tests
9. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy
10. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy

Total = P: 45 = 45

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

12M511 THERMAL ENGINEERING LABORATORY 0 0 3 1.5

1. Experimental study on valve timing diagram in 4-stroke engine cut model
2. Experimental study on port timing diagram in 2-stroke engine cut model
3. Performance test on constant speed 4-stroke diesel engine
4. Variable speed test on multi-cylinder diesel engine
5. Heat balance test on 4-stroke diesel engine
6. Performance test on constant speed single cylinder petrol engine
7. Performance test on high pressure two stage reciprocating air compressor
8. Performance testing of boilers
9. IC engine performance evaluation using PC interface
10. Experiment of heating, ventilation and air conditioning unit
11. Experiment on Refrigeration tutor

Total = P: 45 = 45

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.
2. Rajput.R.K, "Thermal Engineering", Laxmi Publications, New Delhi, 2003.

12M520 MINI PROJECT 0 0 2 1

- **The mini-project involves the following:**
  - **Preparing a project - brief proposal including**
  - Problem Identification
  - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
  - List of possible solutions including alternatives and constraints
  - Cost benefit analysis
  - Time Line of activities
- **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
  - **A presentation including the following:**
  - Implementation Phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the Project
- **Consolidated report preparation**

Total = P: 30 = 30

SEMESTER 6

12M601 DESIGN OF TRANSMISSION SYSTEMS 3 1 0 3.5

SELECTION OF V BELTS AND CHAINS: V belts for given power and velocity ratio, selection of micro V-belts, Selection of roller chain and power speed ratio, silent chain, (6+2)

SELECTION OF V BELTS FOR CNC MACHINES, Poly Vee belts, HTD belts, V-belts of 3V, 5V and 8V types and timing belts – SPZ, SPA, SPB, SPC types, Selection of Belts in application for CNC Machine Tool, Banded Belts – advantages and applications. (6+1)

POWER SCREWS: Forms of threads, force analysis, square and trapezoidal threads, collar friction, design of power screws (for screw jack, lathe, etc.,) Theory of Ball Screws, selection of ball screws CNC Machine Tools. (6+2)

DESIGN OF GEARS: Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, determining dimension of helical gear pair. Design of gears for machine tool applications (6+2)

BEVEL AND WORM GEARS: Nomenclature of straight and spiral bevel gears, Nomenclature, thermal capacity, efficiency, design of a pair of worm gears. Design of worm gear drives for reduction gear boxes (6+2)

MULTI SPEED GEAR BOX: Ray diagram, gear tooth profile correction, finalization of the gear train; gear tooth loads and bearing reactions. Design of gear box for machine tools (5+2)

FRICTION DRIVES: Clutches - role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection. Design of clutch for automobiles (5+2)

BRAKES: Role of brakes-types of brakes-self energizing and de-energizing brakes. Design of internally expanding shoe brakes - calculation of heat generation and heat dissipation in brakes. Design of brake for automobiles (5+2)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:
1. Robert L Norton, "Machine Design - An Integrated Approach", Pearson Education, New Delhi, 2003.
2. Shigley and Mische, "Mechanical Engineering Design", McGraw Hill, Inc., New Delhi, 2000.

REFERENCES:
1. Robert L Mortt, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London, 1992.
2. Maitra.G.M, "Handbook of Gear Design", Tata McGraw Hill, New Delhi, 1998
3. Darle W Dudley, "Hand Book of Practical Gear Design", CRC Press, Florida, 2002.
4. Prabhu.T.J, "Design of Transmission Elements", Mani offset, Chennai, 2003.
5. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s DPV Printers, Coimbatore, 2010
6. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II

12M602 HEAT AND MASS TRANSFER 3 1 0 3.5

MODES OF HEAT TRANSFER: Fourier law of heat conduction, three-dimensional, heat conduction, equations in various co-ordinate systems, steady state heat conduction equation for plane, cylindrical and spherical shapes, Critical radius of insulation, single layer and multi layer-film co-efficient. (6+2)

STEADY HEAT CONDUCTION: Variable thermal conductivity, heat transfer with heat generation in different shapes. Extended surfaces (fins)-numerical methods for varying sections of fins with different end conditions. (5+2)

UNSTEADY HEAT CONDUCTION: Lumped parameter systems, infinite solids, semi-infinite solids, numerical and graphical methods, periodic heating. (5+2)

CONCEPTS OF BOUNDARY LAYER: Differential and integral equations for hydrodynamics and thermal boundary layer. (4+1)

CONVECTION HEAT TRANSFER: Forced Heat transfer from flat plate, laminar and turbulent flow, cylinders and spheres, flow through tubes. Free convection, heat transfer from vertical and horizontal surfaces. (5+2)

RADIATION HEAT TRANSFER: Emissive power, grey body. Radiation heat transfer between surfaces, shape factor. Gas radiation. (4+2)

BOILING AND CONDENSATION: Boiling heat transfer - bubble growth, freezing and melting. Condensation, film condensation and drop wise condensation. (4+1)

HEAT EXCHANGERS: Types-tube arrangements, single and multi tube types, parallel, counter and cross flow, Overall heat transfer coefficient, effectiveness method (NTU) to study performance of heat exchangers, fouling factor . (5+2)

MASS TRANSFER: Rate equations. Mass diffusion in binary mixtures, evaporation in a column, forced convective mass transfer. Heat and mass transfer analogies. (7+1)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:
1. Yunus A Cengel, "Heat Transfer: A Practical Approach", Tata McGraw Hill Inc., New Delhi, 2005.
2. Kothandaraman .C.P, "Fundamentals of Heat and Mass Transfer", New Age International Publishers, Chennai, 1997.

REFERENCES:
1. Yildiz Bayazitogly and Necati Ozisik M, "Elements of Heat Transfer", McGraw Hill International Ed., New York, 1988.
2. Yadav.R, "Heat and Mass Transfer", Central Publishing House, Allahabad, 1994.
3. Frank P Incropera and David P Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley India Private Limited, 2007.
4. Donald Q Kern, "Process Heat Transfer", Tata McGraw Hill Education Private Limited, 2001.
5. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New_index1.html

12M603 OPERATIONS RESEARCH 3 1 0 3.5

INTRODUCTION TO OPERATIONS RESEARCH: Operations research and decision-making, types of mathematical models and constructing the model. Role of computers in operations research (4+1)

LINEAR PROGRAMMING TECHNIQUES: Formulation of linear programming problem, applications and limitations, graphical method, simplex method, The Big –M method, the two–phase method, dual problems. (7+3)

TRANSPORTATION PROBLEMS: Least cost method, North West corner rule, Vogel's approximation method, modified distribution method, optimization models, degeneracy in transportation model, unbalanced and maximization models. (5+2)

ASSIGNMENT MODELS AND SCHEDULING: Difference between transportation problem and assignment problem, Hungarian algorithm, unbalanced assignment problems maximization case in assignment problems, traveling salesman problem (6+2)

INVENTORY CONTROL: Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model. (4+2)

QUEUING MODELS: Queues **–** Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system , queues with breakdowns. (5+1)

PROJECT MANAGEMENT BY PERT AND CPM: Basic terminologies, constructing a project network , network computations in CPM and PERT , cost crashing, resource levelling. (5+2)

GAME THEORY: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game , n person zero sum game, graphical method, and linear programming in game theory. (5+1)

REPLACEMENT MODELS: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement (4+1)

Total = L: 45 + T:15 = 60

TEXT BOOKS:

1. Frederick S. Hillier and Gerald J. Lieberman," Introduction to Operations Research", McGraw-Hill, 2002
2. Kanti Swarup, Gupta P K and Manmohan, "Operations Research", Sultan Chand and Sons New Delhi, 2004.

REFERENCES:

1. Viswanathan .N , Narahari. Y , "Performance Modeling of Automated Manufacturing Systems" , Prentice Hall Inc ,1992.
2. Srinath.L.S, "PERT and CPM – Principles and Applications", East West Press, New Delhi, 1982.
3. Dharani Venkatakrishnan.S, "Operations Research", Keerthi Publication House, Coimbatore, 1991.
4. Gupta and Hira, "Problems in Operations Research", S Chand and Company, New Delhi, 1991.
5. Prem kumar Gupta and Hira.D.S, "Operation Research", S Chand and Company Limited, New Delhi, 1986.
6. Wayne L Winston & Venkataramanan,M, "Introduction To Mathematical Programming", Thomson Learning, 2003
7. http://www.nptel.iitm.ac.in/video.php?subjectId=112106134

12M604 DESIGN FOR MANUFACTURE AND ASSEMBLY 3 1 0 3.5

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY: DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis (6+2)

TOLERANCE ANALYSIS: Process capability, process capability metrics, Cp, Cpk , cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, 6σ concept (6+2)

SELECTIVE ASSEMBLY: Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples. (6+2)

DATUM SYSTEMS: Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, grouped datum system with spigot and recess pair and tongue-slot pair, computation of translational and rotational accuracy, geometric analysis and applications. (5+2)

TRUE POSITION TOLERANCING THEORY: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. (6+2)

FORM DESIGN OF CASTINGS AND WELDMENTS: Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – case studies (5+2)

DESIGN FOR MACHINING: Design features to facilitate machining, datum features - functional and manufacturing, component design-machining considerations, redesign for manufacture, examples. (5+1)

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. (6+2)

Total = L: 45 + T: 15 = 60

TEXT BOOKS:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983.
2. Krulikowski .A, "Fundamentals of Geometric Dimensioning and Tolerancing, Delmar Publishers-New York, 1997.

REFERENCES:

1. Spotts.M. F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 1983.
2. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 2008.
3. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1986.
4. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, 1987.
5. Creveling .C. M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley Longman Inc.,USA, 1997.
6. Pahl.G and Beitz .W, "Engineering Design-Systematic Approach", Springer Verlag Publications, 1996.

12M610 METROLOGY AND DYNAMICS LABORATORY 0 0 3 1.5

1. Gear roll testing (ii) gear concentricity testing
2. Measurement of thread terminology using optical profile projector
3. (i) Angular measurement using sine bar (ii)Calibration of plug gauge using laser micrometer
4. (i) Surface Roughness measurement of machined components (ii) measurement using height master, height gauge
5. Tool nomenclature assessment using tool makers microscope
6. Auto collimator for form measurement
7. Static and dynamic balancing using dynamic balancing machine.
8. Preparation of cam displacement curve and determination of jump speed of a cam.
9. Determination of natural frequencies of transverse and torsional vibrations.
10. Study of undamped free vibration of equivalent spring mass system.
11. Shaft alignment testing.
12. Determination of pressure distribution in journal bearing.
13. Determination of critical speed of shafts.
14. Wear measurement using Pin-On-Disc method.

Total = P: 45 = 45

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

12M611 HEAT TRANSFER LABORATORY 0 0 3 1.5

1. Experiment on Pin Fin apparatus
2. Experiment on natural convective heat transfer from vertical cylinder
3. Experiment on forced heat transfer inside tube
4. Determination of Stefan-Boltzmann constant
5. Determination of emissivity of grey surface
6. Effectiveness of parallel /counter flow heat exchanger
7. Experiment on boiling and condensation apparatus
8. Study on heat transfer in compressor and IC engine cylinder heads using finite element analysis software.
9. Experiment on line heat source apparatus to determine the effective thermal conductivity of two phase materials.
10. Experiment on plane heat source apparatus to determine the effective thermal conductivity of two phase materials.

Total = P: 45 = 45

REFERENCES:

1. Laboratory Manual prepared by Department of Mechanical Engineering.
2. Yunus A Cengel "Heat Transfer; A practical Approach",Tata McGraw Hill Education Private Limited, New Delhi 2005

12M612 INDUSTRIAL VISIT CUM LECTURE 0 0 3 1.5

Pre- requisites

- 12M106 Manufacturing Processes I
- 12M202 Material Science
- 12M206 Concepts of Engineering Design
- 12M304 Manufacturing Processes II
- 12M310 Machine Drawing

- 12M401 Probability, Statistics and Quality Assurance
- 12M403 Computer Numerical Control and Robotics

VISIT TO A PUMP INDUSTRY: Introduction, Bill of materials of an industrial pump, component suppliers, process flow – precedence diagram, manufacturing methods, product testing, production planning and quality assurance. (15)

VISIT TO AN AUTO ANCILLARY INDUSTRY: Introduction, organization structure, roles and responsibilities, cross functional teams, quality systems – control charts, ISO/TS 16949, continuous improvement – 5S, TPM, Kaizen and Poka-yoke. Occupational safety and health – Case studies. (15)

STUDENT – INDUSTRY EXPERT INTERACTION: Product design, development and testing / Industrial automation – Low cost automation / Shop floor best practices / Process planning / Production planning and inventory management, etc. (15)

Note:

- Visits to two local industries and one industry expert guest lecture are mandatory.
- For industrial visits, a Pre-visit and a post-visit questionnaire will be used for evaluation of students.
- Week wise activity plan indicated below will be used.

Activity Plan

ACTIVITY	NO. OF WEEKS
Pre-visit presentation about the Industry no.1 (by the faculty) and questionnaire to be answered by the students.	1
Visit to industry 1	1
Batch wise observation report and presentation for Industry 1	2
ACTIVITY	**NO. OF WEEKS**
Post-visit written test (CA 1)	1
Pre-visit presentation about the Industry no.2 (by the faculty) and questionnaire to be answered by the students.	1
Visit to industry 2	1
Batch wise observation report and presentation for Industry 2	2
Post-visit written test (CA 1)	1
Industry expert talk	1
Batch wise group discussion on the topics from the expert talk	1
Viva-voce exam based on industries visited and expert talk.	2
TOTAL NO. OF WEEKS	**14**

Total = P: 45 = 45

REFERENCES:

1. Industrial Visit Manual prepared by Department of Mechanical Engineering.
2. William K Dalton, Gregg Bruce.R, “Modern Materials and Manufacturing Processes”, Pearson Education, 2007.
3. Askin.R.G and Goldberg.J.B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2003.

SEMESTER 7

12M701 INDUSTRIAL PSYCHOLOGY, SOCIOLOGY AND WORK ETHICS 2 1 0 2.5

INDUSTRIAL PSYCHOLOGY: Objectives – Individual behaviour – Group behavior –Group Dynamics – Leadership Styles – Industrial Fatigue. (5+2)

SOCIAL SYSTEM: Definition – Scope – Significance – Society – Community – Institutions – Culture – Socialization – Social systems. (4+1)

HUMAN RESOURCE MANAGEMENT: Definition – Importance – Functions – Training & Development. (5+2)

HUMAN VALUES: Value crisis in Contemporary Indian Society – Aesthetic Values, Moral and Ethical Values – Values in the Work place (2+2)

WORK ETHICS: Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership. (2+2)

SOCIAL RESPONSIBILITY AND ETHICS: Concept of Social Responsibility – Importance of Social Responsibility – Business Ethics. (4+2)

INTERPERSONAL RELATIONSHIP: Managing emotions – Emotional Intelligence – Building Better interpersonal Relations– Managing the Boss – Dealing with Subordinates – Case Study. (6+2)

MOTIVATION AND PERCEPTION: Meaning – definition – Mechanism – Basic Theories of Motivation – Importance of Perception – Need for Shaping Perception (2+2)

Total = L: 30 + T: 15 = 45

TEXT BOOKS:

1. Vikram Bisen & Priya, "Industrial Psychology", New Age International (P) Ltd., Publishers, 2010.
2. Murthy C.S.V., "Business Ethics", Himalaya Publishing House, 2007.

REFERENCES:

1. Shankar Rao C.N – Sociology- Sultan Chand & Co. – 1998.
2. Dezenzo A David and Robbins P Robbins, "Human Resource Management", John Wiley and Sons, Inc, MA., 2002.
3. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" - Tata McGraw Hill, New Delhi, 2004.
3. Tripathi. A. N., "Human Values", New Age International Pvt. Ltd., New Delhi, 2002.

12M702 INDUSTRIAL ENGINEERING AND MANAGEMENT 2 1 0 2.5

INTRODUCTION : Principles of management **-** Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Evolution of IE. Engineers and Organizational Environment – Social, Economic, Technological and Political. Social Responsibility of Engineers. (3+2)

ORGANIZATIONAL BEHAVIOUR AND HUMAN RESOURCE MANAGEMENT: Significance of OB, Role of leadership, Personality and Motivation. Attitudes, Values and Perceptions at work. HR - Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development – Forms of Business organization. (4+2)

WORK STUDY: Productivity definition, means of increasing productivity, Productivity and work study work study - Definition, aims, procedure for method study, selection of jobs, recording techniques, micro motion study, therbligs, cyclograph and chronocyclo graph, principles of motion economy, design of work place layout, analysis in the form of chart, operation chart, flow process chart, flow diagram, string diagram, man machine chart, two hand chart, simo chart. – time study equipment, performance rating, allowances, number of cycles to be studied, determination of standard time, predetermined motion time systems. (7+2)

JOB EVALUATION, WAGES, INCENTIVES AND WELFARE: Job evaluation, objectives of job evaluation, Methods of job evaluation, Non quantitative and quantitative. – Characteristics of a good wage or a incentive systems, Methods of wage payments, Concept of wage incentive schemes, financial and non financial, Halsly premium plan, rvlerric's multiple piece rate system. Working condition, service facilities, legal legislation – Factories Act, 1948 (4+2)

ERGONOMICS: Definition, human technological system, multidisciplinary engineering approach, Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision, biothermodynamics and bioenergetic (4+1)

MARKETING FEASIBILITY ANALYSIS: Qualitative forecasting methods, quantitative forecasting models – forecast accuracy, long range forecast, short range forecast. (2+2)

FACILITIES LAYOUT AND PLANT LOCATION: Manufacturing facility layouts, Analyzing manufacturing facility layouts, service facility layout. – Factors affecting location decisions, Multi facility location problem, Ware house location problem, minimax location, gravity location problem. (3+2)

INVENTORY MANAGEMENT AND PPC: Views of inventories, nature of inventories, fixed order quantity systems, fixed order period systems, other inventory models, Production planning and control- loading, scheduling, dispatching, (3+2)

Total = L: 30 + T: 15 = 45

TEXT BOOKS:

1. ILO, "Introduction to work study", Universal Publishing Corporation, Bombay, 1986.
2. Norman Gaither and Greg Frazier, "Operations Management", Cengage Learning India pvt. Ltd., 2002.
3. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" - Tata McGraw Hill, New Delhi, 2004.

REFERENCES:

1. Mundel, "Motion and Time Study", Prentice Hall of India, 1995.
2. Ralph M. Barnes, "Motion and Time study", John Wiley and sons, 1990.
3. Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.
4. Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York, 2000.
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-ROORKEE/INDUSTRIAL-ENGINERRING/index.htm

12M703 POWER PLANT ENGINEERING 3 0 0 3

STEAM CYCLES: Rankine cycle-superheat, reheat and regeneration, super critical cycles, combined cycles - binary cycles, cogeneration. (5)

FUEL COMBUSTION: Types of combustion, stokers, fuel and ash handling equipments. Draft- forced, induced and balanced drafts. Selection of fans. Heat recovery equipments-economisers, air preheaters and reheaters, different types of superheaters and de-superheaters. Emission control, flue gas cleaning, particulate and gaseous emission control methods. Boiler testing (5)

THERMAL POWER PLANT: Steam generators-forced circulation, high-pressure boilers and super critical boilers, fluidized bed boiler, boiler accessories and mountings. (5)

HYDROELECTRIC POWER PLANT: Runoff river plants, pumped storage plants, underground stations. Turbine performance, hydel plant axillaries and plant operation. (5)

CONDENSERS COOLING TOWERS: Different types, design factors, air removal, performance calculation. Cooling towers, -natural and mechanical draft types. (5)

DIESEL AND GAS TURBINE POWER PLANT: Classifications, components, selection of engine type**,** gas turbine plant – closed cycle and open cycle plants. (4)

NUCLEAR POWER PLANT: General nuclear fuels used in reactors, elements of nuclear reactor, moderator, control rods, coolants, description of different types of reactors. Radiation hazards, radioactive waste disposal. (4)

RENEWABLE ENERGY SOURCES: Solar energy**-**measurement, methods of utilization, flat plate and concentrating collectors, water heater, air driers, photovoltaic cell. Wind energy - horizontal and vertical types of wing generator. Other plants: Geothermal plants, tidal power plant, biomass and biogas plants, OTEC plants. (6)

POWER PLANT ECONOMICS: Plant load factor and utilization factor, cost economics – tariff rates, demand changes, load distributions. Energy conversion and audit. Maintenance aspects of power plants. (6)

Total = L: 45 = 45

TEXT BOOKS:

1. Nag P K, “Power Plant Engineering”, Tata McGraw Hill, New Delhi, 2004.
2. Arora S C and Domkundwar S, “Power Plant Engineering”, Dhanpat Rai and Sons, New Delhi, 2001.

REFERENCES:

1. Rajput R K, “Power Plant Engineering”, Laxmi Publications (p) Ltd, 2006.
2. Rudramoorthy R, “Thermal Engineering”, Tata McGraw Hill, 2003.
3. Wakil M M El, “Power Plant Technology”, McGraw Hill Book Company Inc., New Delhi, 1985.
4. Ashok V Desai, “Non Conventional Energy”, Wiley Eastern Limited, New Delhi, 1990.
5. Ramalingam K K, “Power Plant Engineering”, Scitech Publication Pvt. Ltd, 2002.

12M704 FINITE ELEMENT ANALYSIS 3 1 0 3.5

INTRODUCTION TO FEM: Engineering design analysis-meaning and purpose, basic concepts of FEM. Applicability of FEM to structural, heat transfer and fluid flow problems. Advantages and limitations of FEM. Test for convergence. Element choice. Commercial finite element packages-organization-advantages and limitations. (6+2)

STATIC ANALYSIS: General procedure of FEM. Skeletal and continuum structures. Discretization of domain-basic types of elements.Formulation of element stiffness matrices-1D spar and beam elements, 2D triangular and quadrilateral elements, Isoparametric elements, higher order elements, treatment of boundary condition. (14+5)

DYNAMIC ANALYSIS: Equations of motion for dynamic problems. Consistent and lumped mass matrices. Formulation of element mass matrices. Free vibration problem formulation. (8+3)

HEAT TRANSFER AND FLUID FLOW ANALYSIS: Basic equations of heat transfer and fluid flow problems. Finite element formulation. One dimensional heat transfer and fluid flow problems. Steady state and transient heat conduction problems. (7+2)

INTRODUCTION TO CFD: Explicit and implicit methods –overview of finite difference and finite volume methods, potential function and stream function formulations, in viscid and viscous incompressible flow, Introduction to coupled and uncoupled fluid flow analysis. (6+1)

DESIGN OF MACHINE STRUCTURES: Force distribution on different parts of machine structure, design of the parts, static, dynamic and thermal analysis of the parts using finite element method. Material redistribution to minimize stresses and deflection. Optimisation of location of ribs to maximize rigidity. (4+2)

Total = L: 45 + T: 15 = 60

PROJECT BASED LAB SESSIONS

- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

TEXT BOOKS:

1. Chandrupatla T R and Belegundu A D, “Introduction to Finite Elements in Engineering”, Prentice Hall India, 2009.
2. Logan D L, “A First Course in the Finite Element Method”, CL Engineering, 2011

REFERENCES:

1. Larry J. Segerlind, “Applied Finite Element Analysis”, John Wiley and Sons, 1984
2. Rao S S, “The Finite Element Method in Engineering”, Elsevier, 2011.
3. Cook R D, Malkus D S and Plesha M E, “Concepts and Applications of Finite Element Analysis”, Wiley India Pvt Ltd, New Delhi, 2007.
4. Zienkiewicz OC, Cheung YK, “Finite Element Method”, Butterworth Heinemann, 2007.
5. Nils Erik Wilberg, “Finite Element Method Basics”, Overseas Press (India) Pvt. Ltd,. 2006.
6. http://nptel.iitm.ac.in/video.php?subjectId=112106135

12M710 COMPUTER AIDED ENGINEERING LABORATORY 0 0 3 1.5

1. Solid modeling of engineering components of a typical assembly and extraction of production drawings of the above components and assembly.
2. Determination of stresses and factor of safety in critical machine components by FEM and experimental validation of the results by strain measurement.
3. Dynamic analysis of chassis frame of an automobile.
4. Thermal analysis of IC engine components using FEA software.
5. Crash analysis of an automobile using FEA software.
6. Kinematic and dynamic analysis of mechanisms using mechanism analysis software.
7. Thermal Analysis of electronic equipments.
8. Analysis of flow through pipes using CFD software.
9. Simulation of stamping process using metal forming software.
10. Tolerance stack up using simulation software.

PROJECT BASED LAB SESSIONS

- ❖ Design/Selection of machine elements will be based on estimated loads and other design requirements collected by the student from field data with extensive support from manufacturers catalogues (wherever applicable).

Total = P: 45 = 45

TEXT BOOKS:

1. Lab manual prepared by department of mechanical engineering.
2. Shigley J E and Uicker J J, “Theory of Machines and Mechanisms”, Oxford University Press, 2009.

REFERENCES:

1. Chandrupatla T R and Belegundu A D, “Introduction to Finite Elements in Engineering”, Prentice Hall India, 2009.
2. Logan D L, “A First Course in the Finite Element Method”, CL Engineering, 2011.
3. Myszka David H.. “Machines And Mechanisms: Applied Kinematic Analysis”, Prentice Hall India, 2009.
4. Hibbeler R C, “Mechanics of Materials”, Pearson Education, 2007.
5. Robert L. Norton, “Design Of Machinery: An Introduction To The Synthesis And Analysis Of Mechanisms And Machines”, Mcgraw-hill, 2011.
6. Srinivas et al., “Finite Element Analysis Using ANSYS”, Prentice Hall India, 2010.

12M711 AUTOMATION AND SENSORICS LABORATORY 1 0 3 2.5

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of a thermocouple to monitor temperature in a thermal chamber and controlling a fan and heating source to maintain the temperature of the chamber within a specified tolerance limits.
6. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
7. Interfacing of hot wire anemometer with data acquisition system to measure the air flow rate and calibration of the same
8. Measurement of damping ratio of a machine tool base from free vibration studies using an impact hammer and an accelerometer pick up with data acquisition system.
9. Inspection using Machine vision System
10. Development of strain gauge set up to measure strains in a statically loaded cantilever beam and calibration of the same.
11. Control of speed, direction and number of revolutions of a stepper motor using PC
12. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

Total = L: 15 + P: 45 = 60

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

12M720 PROJECT WORK I 0 0 4 2

- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalisation of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Future trends in providing alternate solutions
- Consolidated report preparation of the above

Total = P: 60 = 60

SEMESTER 8

12M820 PROJECT WORK II 0 0 12 6

- **The project work involves the following:**
  - **Preparing a project - brief proposal including**
  - Problem Identification
  - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
  - List of possible solutions including alternatives and constraints
  - Cost benefit analysis
  - Time Line of activities
- **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
  - **A presentation including the following:**
  - Implementation Phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the Project
- **Consolidated report preparation**

Total = P: 180 = 225

PROFESSIONAL ELECTIVES

DESIGN ENGINEERING

12M001 COMPUTER AIDED DESIGN 3 0 0 3

OVERVIEW OF CAD SYSTEMS: Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems. (7)

INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS: Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software. (9)

GEOMETRIC MODELING: Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, boolean operations. Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry(CSG) and Analytical Solid Modeling(ASM) (7)

PARAMETRIC DESIGN AND OBJECT REPRESENTATION: Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations. (6)

PRODUCT DESIGN AND DEVELOPMENT: Automated 2D drafting - basics, Mechanical assembly - bill of materials generation. Mass property calculations. (6)

OPTIMIZATION TECHNIQUES: Optimization-need, objective functions and constraints. Mathematical modeling and analysis. (4)

CASE STUDY: Design and optimsation procedure of shafts, flywheel, gears and journal bearing using computer packages. (6)

Total = L: 45 = 45

TEXT BOOKS:

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw- Hill Inc., New Delhi, 2007.
2. Radhakrishnan P and Subramanyan S, "CAD/CAM/CIM", New Age International (P) Ltd., 2004.

REFERENCES:

1. Radhakrishnan P and Kothandaraman C P, "Computer Graphics and Design", Dhanpat Rai and Sons, New Delhi, 2002.
2. Vera B Anand, "Computer Graphics and Geometric Modeling for Engineers", John Wiley and Sons Inc., New Delhi, 2000.
3. Barry Hawhes, "The CAD/CAM Process", Pitman Publishing, London, 1998.
4. William M Newman and Robert Sproul, "Principles of Interactive Computer Graphics", McGraw Hill Inc., New Delhi, 1994.
5. Latit Narayan, Mallikarjuna Rao, Sarcar, "Computer Aided Design and Manufacturing, Prentice Hall of India, New Delhi, 2008.
6. Rao S S, "OptimisatIon Techniques", Wiley Eastern, New Delhi, 2003.

12M002 ADVANCED STRENGTH OF MATERIALS 3 0 0 3

CURVED BEAMS : Circumferential stress at a point in a curved beam, Wrinkler Bach formula-limitations, curved beam with restrained ends. Closed ring subjected to a concentrated load and uniform load. (7)

BEAMS ON ELASTIC SUPPORTS: Beam with a concentrated load. Use of principle of superposition. Beam supported on equally spaced separate elastic supports-UDL over part of the beam. (8)

FLAT PLATES IN BENDING: Plates in which bending action is dominant-small deflections. Stress in a circular plate with UDL, simply supported and fixed edges-concentrated load. Stresses in square and rectangular plates with UDL, concentrated load at center. (7)

ROTATING DISKS: Solid disk, disk with a central hole with external and internal pressures, disks of uniform strength, plastic collapse of rotating disks. Rotating cylinders (circular). Disk of varying thickness. (7)

TORSION OF NON CIRCULAR SECTIONS: Torsion of bar having a rectangular sections, elastic membrane (soap film) analogy hollow thin walled tubes. (8)

THICK WALLED CYLINDERS: Lame solution for principal stresses. Maximum stresses, radial deflection, failure theories, applications. Methods of increasing the elastic strength by pre-stressing, analysis of effects of stresses of shrinking a hollow cylinder made of thin walled laminations, auto frettage. (8)

Total = L: 45 = 45

TEXT BOOKS:

1. Boresi A P and Schmidt R J, "Advanced mechanics of Materials", John Wiley and Sons, New Delhi, 2002.

REFERENCES:

1. Cook R D, and Young, "Advanced Mechanics of Materials", John Wiley Co., New Delhi, 1987.
2. Den Hartog, "Advanced Strength of Materials", McGraw Hill Inc., New Delhi, 1975.
3. Rajput R K, "Strength of Materials', S. Chand & Co. ltd, New Delhi, 2010.

12M003 FAILURE ANALYSIS AND DESIGN 3 0 0 3

MATERIALS AND DESIGN PROCESS: Factors affecting the behavior of materials in components, effect of component geometry and shape factors, design for static strength, stiffness, designing with high strength and low toughness materials, designing for hostile environments, material processing and design, processes and their influence on design, process attributes, systematic process selection, screening, process selection diagrams, ranking, process cost. (7)

FRACTURE MECHANICS: Ductile fracture, brittle fracture, Cleavage-fractography, ductile-brittle transition-Fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage (6**)**

LINEAR ELASTIC FRACTURE MECHANICS: Griffith theory, Energy release rate, instability and R-curve, stress analysis of cracks-stress intensity factor, K-threshold, crack growth instability analysis, crack tip stress analysis. (6)

ELASTIC PLASTIC FRACTURE MECHANICS: Crack tip opening displacement(CTOD), J integral, relationship between J and CTOD (7)

DYNAMIC AND TIME-DEPENDENT FRACTURE: Dynamic fracture, rapid loading of a stationary crack, rapid crack propagation, dynamic contour integral, Creep crack growth-C Integral, Visco elastic fracture mechanics, viscoelastic J integral (6)

DETERMINATION OF FRACTURE TOUGHNESS VALUES: experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, effect of temperature, strain rate on fracture toughness. (7)

FAILURE ANALYSIS TOOLS: Reliability concept and hazard function, life prediction, life extension, application of poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, Process FMEA , analysis causes of failure, modes, ranks of failure modes, fault tree analysis, industrial case studies/projects on FMEA. (6)

PROJECT BASED LAB SESSIONS

- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

Total = L: 45 = 45

TEXT BOOKS:

1. John M Barsoom and Stanley T Rolte , "Fracture and Fatigue Control in Structures", American Society For Testing & Materials, 1999.
2. R. J. Shipley And W. T. Becker, " ASM Handbook Volume 11 : Failure Analysis and Prevention", ASM International, 2002.

REFERENCES:

1. Joseph Shigley, Charles Mischke, Budynas Richard, Keith Nisbett, "Mechanical Engineering Design", Tata Mc-graw Hill Education, 2008.
2. Mahmoud M Farag, “Material Selection for Engineering Design”, CRC Press, 2005.
3. Faculty of Mechanical Engineering, PSG College of Technology, “Design Data Book”, DPV Printers, 1993.
4. Michael F Ashby, “Material Selection in Mechanical Design”, Butterworth – Heinemann, 1999.
5. T.L.Anderson, “Fracture Mechanics: Fundamentals and Applications”, Taylor & Francis Group, 2005.

12M004 VIBRATION AND NOISE ENGINEERING 3 0 0 3

INTRODUCTION: Relevance of and need for vibrational analysis. Mathematical modeling of vibrating systems-discrete and continuous systems-single-degree of freedom systems, free and forced vibrations, various damping models. (7)

TWO DEGREES OF FREEDOM SYSTEMS: Generalized co-ordinates, principal co-ordinates, derivation of equations of motion, co-ordinate coupling, Lagrange’s equation. (7)

MULTI DEGREES OF FREEDOM SYSTEMS: Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Stodala, Dunkerley, Holzer and matrix iteration methods, branched system, geared system. (7)

TRANSIENT VIBRATION: Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum. (7)

VIBRATION TESTS, MEASUREMENTS AND CONTROL: Free and forced vibration tests, Measurement of vibration, FFT analyzer. Methods of vibration control - excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials-viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitative treatment only), untuned viscous damper, vibration isolation. (12)

NOISE: Properties of sound – sound level meter. Sound isolation- machine enclosures, silencers and mufflers. (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Ashok Kumar Mallik, “Principles of Vibration control”, Affiliated East-West Press (P) Ltd., New Delhi Press, 1990.
3. Lewis H Bell, “Industrial Noise Control Fundamentals and Applications”, Marcel Dekkev Incl., New York, 1982.

REFERENCES:

1. Tse Morse and Hinkle, “Mechanical Vibration”, Prentice Hall of India Ltd., New Jersey,1987.
3. Grover G K, "Mechanical Vibrations ", New Chand and Brothers, Roorkey, 1989.
3. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New Delhi, 1990.
4. Kewal Pujara. and Pujara R.S., “Noise for Engineers”, Dhanpat Rai and Sons, New Delhi, 1984.
5. Rao S S, "Mechanical Vibrations", Addison Wesley, Longman, 2009.

12M005 DESIGN OF ROTATING EQUIPMENTS 3 0 0 3

INTRODUCTION: Principles of fluid flow, Basic theory of rotating equipment. (2)

PUMPS: Different types of pump - characteristic curves. Theory of centrifugal pump impeller-vortex theory, design of impeller, volute and diffusers. Specific speed and design constants. (6)

DESIGN OF MIXED FLOW IMPELLERS: Geometric relationship, axial flow pumps, design. Use of aerofoil data for impeller design, guide vane, pump casing. (6)

FANS: Fan laws, performance coefficients, effect of change in fan speed, density, series and parallel operation, fan design losses, blade shape, casing. (6)

PROPELLER FANS: Cross flow fans, principle of operation, applications, regulation of volume flow, sources of vibration in fans, noise attenuation testing. (6)

BLOWERS: Types, centrifugal blower - design procedure, selection, performance, special applications, control of volume flow. (4)

PERFORMANCE ESTIMATION: Instrumentation test rig layout, measurement of pressure, temperature, use of hot wire anemometer, boundary layer probes, measurement of sound, different types and characteristics. (4)

COMPRESSORS: Different types of compressors - characteristic curves. Centrifugal compressor - multistage arrangement, blade design, types of diffusers, performance, series and parallel operation. (4)

AXIAL FLOW COMPRESSORS: Cascade theory, efficiency, two dimensional cascade, velocity triangles and stage loading, stage reaction, losses, compressor-testing procedure. (4)

DISC STRESSES AND CRITICAL SPEED: Determination of disc stresses – sum and difference curves, Critical speeds of two bearing and three bearing shafts, torsional critical speeds (3)

Total =L: 45 = 45

TEXT BOOKS:

1. Val S Lobanoff and Robert R Ross,"Centrifugal Pumps Design and Application", Jaico Publishing House, Madras.1996.
2. Allan Wallis R, "Axial Flow Fans and Ducts", John Wiley and Sons, New York, 1983.

REFERENCES:

1. Ronald P Lapina, "Estimating Centrifugal Compressor Performance", Gulf Publishing Company, 1982.
2. Church S Austin and Jagdish Lal, "Centrifugal pumps and blowers", Metropolitan Book Co. Pvt.Ltd, Delhi.1973

12M006 THEORY OF ELASTICITY AND PLASTICITY 3 0 0 3

ANALYSIS OF STRESS AND STRAIN: Stress at a point, stress tensor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions. Measurement of strain using strain rosettes (9)

CONSTITUTIVE EQUATIONS: General theory, generalized Hooke's law, equations of elasticity, Mitchel-Beltrami and Navier equations, formulation of the general elasticity problem, boundary conditions. (9)

SOLUTION OF SOME SPECIAL BOUNDARY VALUE PROBLEMS: Two dimensional problems in rectangular and polar co-ordinates, Airy's stress function. A few representative 3D problems - torsion and bending of non-circular prismatic bars (Saint-Venant's solution), membrane analogy. (9)

PLASTICITY: Plastic flow and its microscopic and macroscopic descriptions, continuum plasticity, stress-strain curves of real materials, definition of yield criterion, concept of a yield surface in principal stress space, yield criteria, tresca, Von Mises. (8)

PLASTIC STRAIN ANALYSIS: Prandtl-Reuss and Levy-Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviatoric components, plastic potential, plastic instability, work hardening, effective stress and effective strain, strain rates and temperature effects on flow stress. Introduction to slip line field theory (10)

Total = L: 45 = 45

TEXT BOOKS:

1. Timoshenko S P and Goodier J N, " Theory of Elasticity", McGraw-Hill, 2010.
2.. Chakrabarthy J., "Theory of Plasticity", Butterworth-Heinemann, 2006.

REFERENCES:

1. Boresi A P, Schmidt R J and Sidebottom O M, "Advanced Mechanics of Materials", John Wiley and Sons, Inc, 1993.
2. Durelli A J, Phillips E A and Tsao C H, "Introduction to the Theoretical and Experimental Analysis of Stress and Strain", McGraw Hill, New York,1958.
3. Calladine C R, "Plasticity for Engineers", Ellis Horwood,1985.
4. Dieter G E, "Mechanical Metallurgy", McGraw Hill,1988.
5. Dally J W and Riley W F, "Experimental Stress Analysis", McGraw Hill International, 1991.

12M007 MECHANICS OF COMPOSITE MATERIALS 3 0 0 3

INTRODUCTION: Modern materials in design, types, metals, polymers, ceramics, composites. Polymers-Classification, properties of thermo plastics, properties of thermo setting plastics, applications, merits and demerits. Classification of composites, Honey comb composites, advantages, applications. Matrix and their role, principal types of fibre and matrix materials. (8)

PROCESS AND CHARACTERISTICS OF COMPOSITES: Manufacture of polymer matrix composites-Lay up and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, advantages and limitations of different processes. Manufacture of metal matrix and ceramic matrix composites. Advantages, limitations and characteristics of ceramic and metal matrix composites. (8)

CONCEPTS OF SOLID MECHANICS: Stress and strain, Strain Energy, Plane stress and plane strain, Generalized Hook's Law for different types of materials, material symmetry, Engineering constants, coordinate transformation, thermal effects and moisture effects, (8)

MICRO MECHANICAL BEHAVIOUR OF A LAMINA: Volume and mass fractions, density and void content, evaluation of elastic moduli, ultimate strengths of a unidirectional lamina, coefficients of thermal and moisture expansion. (7)

MACRO MECHANICAL BEHAVIOUR OF A LAMINA: Hook's Law for a two dimensional unidirectional lamina and angular lamina, evaluation of elastic moduli for unidirectional and angle lamina, engineering constants of unidirectional and angle lamina, strength failure theories. (7)

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Laminate code, stress - strain behaviour in a laminate, Resultant forces and moments in a laminate, interlaminar stresses in laminates. (7)

Total = L: 45 = 45

TEXT BOOKS:

1. Autar K Kaw, "Mechanics of Composite Materials", CRC Press, NY, 1997.
2. Agarwal B D and Broutman L J, "Analysis and Performance of Fibre Composites", John Wiley and Sons Inc, 1990.
3. Matthews F L and Rawlings R D, "Composite Materials: Engineering and Science", Chapman and Hall, London, 1994.

REFERENCES:

1. Ronald F Gibson, "Principles of Composite Material Mechanics", McGraw Hill Book Co, 1994.
2. Robert M Jones, "Mechanics of Composite Materials", McGraw Hill Book Co, 1970.
3. Terry Richardson, "Composites - A Design Guide", Industrial Press Inc, NY, 1987.
4. Sanjay K Mazumdar, "Composites Manufacturing", CRC Press, NY, 2003.

12M008 BIO-MECHANICS 3 0 0 3

INTRODUCTION TO BIOMECHANICS: Basic Terminology and Concepts – Mechanical properties of soft tissues, bones and muscles. (11)

BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM: Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and Spinal Nerve Roots, Skeletal Muscle. (11)

BIOMECHANICS OF JOINTS: Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow the Wrist and Hand. (12)

BIOMECHANICS OF HUMAN MOTION: Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment, biomechanics of Gait. (11)

PROJECT BASED LAB SESSIONS

- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

Total = L: 45 = 45

TEXT BOOKS:

1. Susan J Hall, "Basic Biomechanics", The McGraw-Hill Companies Inc., 2011.
2. Jay D Humphrey and Sherry L Delange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer-Verlag, 2010.

REFERENCES:

1. Margareta Nordin and Victor H Frankel, "Basic Biomechanics of the Musculoskeletal System", Lippincott Williams and Wilkins, 2001.
2. Ozkaya, Nihat, Nordin and Margareta, "Fundamentals of Biomechanics: Equilibrium, Motion and Deformation", Springer, 2009.

12M009 INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS 3 0 0 3

AIRCRAFT INDUSTRY OVERVIEW: Evolution and history of flight, types of aerospace industry, key players in aerospace industry, aerospace manufacturing, aerospace industry trends, advances in engineering/CAD/CAM/CAE tools and materials technology, global and Indian Aircraft Scenario. Functioning aircraft industries Airbus, Boeing and HAL (6)

INTRODUCTION TO AIRCRAFTS: Basic components of an aircraft, structural members, aircraft axis system, aircraft motions, control surfaces and high lift devices. Types of aircrafts –conventional design configurations based on power plant location, wing vertical location, intake location, tail unit arrangements, landing gear arrangements Functioning unconventional aircrafts: Civil and military types (6)

MECHANICAL SYSTEMS : Environmental control systems(ECS), pneumatic systems, hydraulic systems, fuel systems, landing gear systems, engine control systems, ICE and rain protection systems, cabin pressurization and air conditioning systems, steering and brakes systems, auxiliary power unit. Functioning above systems in Airbus 380 aircraft (5)

ELECTRICAL AND ELETRONIC SYSTEMS: Electrical and Electronic Systems, Avionics, flight controls, autopilot and flight management systems, navigation systems, communication, information systems, radar system, Functioning above systems in Boeing 787 aircraft (5)

BASIC PRINCIPLES OF FLIGHT: Significance of speed of sound, air speed and ground speed, properties of atmosphere, Bernoulli's equation, forces on the airplane, airflow over wing section, pressure distribution over a wing section, generation of lift, drag, pitching moments, types of drag, lift curve, drag curve, lift/drag ratio curve, factors affecting lift and drag. (6)

AEROFOIL : Aerofoil nomenclature, types of aerofoil, center of pressure and its effects, wing section-aerodynamic center, aspect ratio, effects of lift, drag, speed, air density on drag. Testing of airfoil models in a wind tunnel. (4)

STABILITY AND CONTROL: Degree of stability – lateral, longitudinal and directional stability and controls of aircraft. Effects of flaps and slats and lift coefficients, control tables, stalling, landing, gliding turning, speed of sound, mach numbers, shock waves (5)
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AIRCRAFT PERFORMANCE AND MANEUVERS: Power curves, maximum and minimum speeds of horizontal flight, effects of changes of engine power, effects of altitude on power curves, forces acting on a aeroplane during a turn, loads during a turn, correct and incorrect angles of bank, aerobatics, inverted maneuvers, maneuverability. Visiting aircraft maintenance shop (8)

Total = L: 45 = 45

TEXT BOOKS:

1. Kermode A C, "Flight without Formulae", Pearson Education (Singapore) Pte. Ltd., 2008.
2. Kermode A C, D. R. Philpott, R. H. Barnard, "Mechanics of Flight", Prentice Hall, 2006.
3. Shevell, "Fundamentals of Flight", Pearson Education, 1989.

REFERENCES:

1. Anderson John D. Jr, " Introduction to Flight", McGraw Hill Publishers, 2007.
2. Ian Moir and Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2008
3. Course Material of Infosys.

12M010 DESIGN OF AIRCRAFT SYSTEMS 3 0 0 3

OVERVIEW OF THE AIRCRAFT DESIGN PROCESS: Introduction, phases of aircraft design, aircraft conceptual design process, conceptual stage, preliminary design, detailed design, design methodologies. Use of software for aircraft conceptual design (4)

INTRODUCTION TO AIRCRAFT STRUCTURES: Types of structural members of fuselage and wing section ribs, spars, frames, stringers, longeron, splices, sectional properties of structural members and their loads, types of structural joints, type of loads on structural joints. Demonstration of various forces using aircraft models (5)

AIRCRAFT LOADS: Aerodynamic loads, inertial loads, loads due to engine, actuator loads, maneuver loads, VN diagrams, gust loads, ground loads, ground conditions, miscellaneous loads. (4)

AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES : Material selection criteria, aluminum alloys, titanium alloys, steel alloys, magnesium alloys, copper alloys, nimonic alloys, non metallic materials, composite materials, use of advanced materials smart materials, manufacturing of structural members, overview of types of manufacturing processes for composites, sheet metal fabrication ,machining, welding, super-plastic forming and diffusion bonding. Preparing of aircraft components using composite materials. (5)

STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES: Theory of plates-analysis of plates for bending, stresses due to bending, plate deflection under different end conditions, strain energy due to bending of circular, rectangular plates, plate buckling, compression buckling, shear buckling, buckling due to in plane bending moments, analysis of stiffened panels in buckling, rectangular plate buckling, analysis of stiffened panels in post buckling, post buckling under shear, sample exercises. Structural analysis of aircraft structures using FEM software (7)

THEORY OF SHELLS: Analysis of shell panels for buckling, compression loading, shear loading / shell shear factor, circumferential buckling stress, Sample exercises. (5)

THEORY OF BEAMS: Symmetric beams in pure bending, deflection of beams, unsymmetrical beams in bending, plastic bending of beams, shear stresses due to bending in thin walled beams, bending of open section beams, bending of closed section beams, shear stresses due to torsion in thin walled beams, sample exercises. (6)

THEORY OF TORSION: Shafts of non-circular sections, torsion in closed section beams, torsion in open section beams, multi cell sections, sample exercises. (4)

AIRWORTHINESS AND AIRCRAFT CERTIFICATION: Definition, airworthiness regulations, regulatory bodies, type certification, general requirements, requirements related to aircraft design covers, performance and flight requirements, airframe requirements, landing requirements, fatigue and failsafe requirements, emergency provisions, emergency landing requirements. (5)

Total = L: 45 = 45

TEXT BOOKS:
1. Raymer Daniel P. Ph. D, "Aircraft Design: A Conceptual Approach", AIAA Education Series, 2002.
2. Michael Niu, ""Airframe Stress Analysis and Sizing", Technical Book Co, 2005.

REFERENCES:
1. Roger D Schaufele, "The Elements of Aircraft Preliminary Design", Aries Publications, 2000.
2. Filippo De Florio, "An Introduction to Aircraft Certification", Butterworth-Heinemann, 2011.

12M011 SYSTEM MODELING AND CONTROL 3 0 0 3

CONTROL SYSTEM FUNDAMENTALS: Basic elements of control systems – open loop and closed loop control – elements of closed loop control system – SISO,MIMO systems , sampled data, digital control systems. (4)

MATHEMATICAL FOUNDATION: Matrix theory, Differential Equations and Laplace Transform (3)

MATHEMATICAL BASICS OF CONTROL SYSTEMS: Block diagrams, Block diagram reduction, signal flow graphs, Mason's gain formula ,Transfer function, translational and rotational mechanical transfer function, Electrical and electro-mechanical system transfer functions, DC motor transfer function, Examples of modeling and transfer functions (5)

BASIC CONTROL THEORY: Poles and zeros; 1st order systems , 2nd order systems , More than 2 poles; zeros; nonlinearities and linearization, PID controllers (5)

TIME DOMAIN ANALYSIS: Stability; Routh-Hurwitz criterion, Stability analysis, Steady state error analysis, Root locus introduction, Root locus example, Design of transient response using root locus, Positive feedback, Examples of design via root locus, Steady-state error compensation, Transient response compensation; transient and steady-state error compensation, Compensation examples, Feedback compensation and its physical realization, Feedback design examples (12)

FREQUENCY DOMAIN ANALYSIS: Frequency response; bode plots, Bode plot examples, Gain margin and phase margin, Design using the frequency response; lead, lag, lead-lag compensators, The state-space representation, Solving the state equations in the time and space domains, State equation examples, Stability and steady-state error in state space (10)

REVIEW: Modeling and transfer functions (2)
REVIEW: Root locus, feedback design (2)
REVIEW: Frequency domain and design (2)

Total = L: 45 = 45

TEXT BOOKS:
1. Nise, Norman S. "Control Systems Engineering", Hoboken, NJ: John Wiley, 2003.
2.. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall, 2010

REFERENCES:
1. Benjamin C Kuo and Farid Golnaraghi, "Automatic Control Systems", Wiley, 2002
2. Gopal M, "Control systems : Principles and Design", Tata Mc Graw-Hill Publishing Company Ltd, New Delhi, 2002.

12M012 PRECISION MACHINE DESIGN 3 0 0 3

INTRODUCTION TO PRECISION ENGINEERING: Precision manufacturing, Intelligent manufacturing – objectives, Reconfigurable systems. (3)

MOTION ERRORS: Errors and error measurements, Model of measurement, Statistical measurements, Propagation of errors, Motion errors principle –translational body, rotational body, geometric and kinematic errors, other types of errors in machines – thermal, cutting force induced, environmental, common geometric errors – cosine, abbe, dead path errors, Classification of errors – systematic and random errors, synchronous and asynchronous errors, PITE and PDTE, Methodologies of error elimination, Future vision in machine error inspection, CNC machine error assessment – positioning accuracy using Laser interferometer, contouring assessment using kinematic ball bar system. CNC machine error assessment (9)

THERMAL PROBLEMS IN MACHINE TOOLS: Machine tool thermal properties, heating up and thermal displacement patterns, Heat sources – belt transmissions, ball screw, slide and rolling guide joints , rolling guides, spindles and electro spindles, Rolling bearings, Lubricants – lubrication methods, Heat transfer, significance, heat conduction, convection, radiation, forced cooling. (6)

MODELING, SIMULATION AND OPTIMIZATION – THERMAL BEHAVIOR: thermal model design fundamentals, simulation and analysis – optimization, Diagnostics, Modeling and compensation, Main trends in improvement of thermal properties. (6)

DESIGN STRATEGIES FOR MACHINE TOOLS: Standard sizes, Precision engineering principles– design, modeling and simulation , Design roadmap – conceptual analysis, materials selection, kinematic design of bearing and guide ways, Structural analysis – static and dynamic analysis , Key components – guide ways – selection, precision linear and rotating movement, Bearing – types of bearings ,applications , Second order phenomena –modeling, parasitic error ,noise, Vibration isolation – design and Inspection, Commercial products – air bearings, linear motor actuators (LMA), gantry, linear motor stage, Micro machines – design approach, design challenges – kinematics, interactive forces, actuators, Miniaturized controller, Cost/Accuracy ratio, Precision machine structures and concepts – linear slide design, SCHNELLE Machine, Moore nanotechnology systems – slow slide servo machining, Manchester micromachine. Miniaturized controller. (7)

PARALLEL KINEMATIC MACHINES (PKM): Serial and parallel systems, Precision design of PKM – need of PKM ,low cost, degrees of freedom, workspace volume, high stiffness and agility, repeatability in movement, low inertia, Configurations and characteristic issues – degrees of calculation, Design principles – Kinematic modeling. (3)

PRECISION CONTROL: Fundamentals of motion control , system modeling and performance assessment , linear dynamics, nonlinear dynamics – force ripple, friction, hysteresis, incorporating nonlinear dynamics, Control design strategies – PID feedback, feed forward control, ripple, RBF compensation, internal model control, Case study: Design of piezoelectric actuator – piezoelectric actuator, LVDT, adaptive controller**.** (3)

ACTUATORS, TRANSMISSION AND SENSORS: Electric actuators and electric drives – stepper, DC, AC, linear Motors, Solid state actuators and piezoelectric actuators – mechanical actuators, friction drives, stiffness, friction drive assembly, control scheme for positioning, positioning measurement, Lead screw, Ball screws, Flexures, Sensors – position measurement- encoder, potentiometer, opto transducer, linear variable displacement transformer, strain gage, Velocity, Acceleration and Torque measurements. (3)

VOLUMETRIC POSITIONING ERRORS: Positioning error modeling – rigid body, non rigid body errors, machine configurations and positioning errors, Positioning error compensation modeling – displacement, squareness and straightness, angular, nonrigid body, 3D grid point, thermal expansion and distortion compensations, straightness errors, temperature correlation and linear interpolation, Positioning error measurement using laser interferometer - direct measurement, indirect measurement – body diagonal displacement , vector or sequential step diagonal displacement measurement , Applications – Siemens, Fanuc, Heidenhain, MDSI controllers– offline real time error compensation , Current issues in modeling of machine errors – definitions of 3D volumetric error based on body diagonal errors. Positioning error modeling (5)

Total = L: 45 = 45

TEXT BOOK:

1. Samir Mekid, “Introduction to Precision Machine Design and Error Assessment”, CRC-Press, Taylor and Francis Group, New York, 2009.

REFERENCES:

1. Alexander H Slocum, “Precision Machine Design”, Prentice Hall Publishers, 1992.
2. Moore W R, “Foundations of Mechanical Accuracy”, T he Moore Special Tool Company, Bridgeport, Connecticut, 1970.
3. Nakazawa H, “Principles of Precision Engineering”, Oxford University Press, Oxford, 1994.
4. Smith S.T, Chetwynd D.G, “Foundations of Ultra – Precision Mechanism Design”, Gordon and Breach Publishers, Switzerland, 1992.
5. Evans C.E., Hocken R.J., Estler W.T., “Self-Calibration Reversal, Redundancy, Error Separation and Absolute Testing”, CIRP Annals, Vol.45/2, 1996.

12M013 BIOMECHANICS OF TISSUES AND JOINTS

3 0 0 3

INTRODUCTION OF MECHANICS: Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar & Non-coplanar and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia. (9)

HARD TISSUE MECHANICS: Bone structure & composition, mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models- anisotropy, Electrical properties of bone, fracture mechanisms. (9)

SOFT TISSUE MECHANICS: Pseudo elasticity, nonlinear stress-strain relationship, Viscosity, Structure, Function and mechanical properties of skin, ligaments and tendons. (9)

BIOMECHANICS OF JOINTS: Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, mechanics of the elbow, mechanics of shoulder, mechanics of spinal column, mechanics of hip, mechanics of knee, mechanics of ankle. (9)

LOCOMOTION: Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis. (9)

Total = L: 45 = 45

TEXT BOOKS:

1. Nihat Ozkaya and margareta Nordin, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", Springer- Verlag; Second Edition, 1999.
2. Susan J Hall, "Basic Biomechanics", McGraw Hill, Columbus- OH, Second Edition, 1995.

REFERENCES:

1. Fung Y C, " Biomechanics: mechanical properties of living tissues", Second Edition. Springer-Verlag, 1993.
2. Author T Johnson, "Biomechanics & Exercise Physiology", John Wiley & Sons, NY, 1991.
3. Ghista D N, "Biomechanics of Medical Devices", Macel Dekker, 1982.
4. US Patents website, www.freepatentsonline.com

MANUFACTURING ENGINEERING

12M015 COMPUTER INTEGRATED MANUFACTURING 3 0 0 3

THE MEANING AND SCOPE OF CIM: Introduction to CIM, definition of CIM, CIM wheel, evolution of CIM, development of numerical control, computers, computer–aided design (CAD), computer-aided manufacturing (CAM), islands of automation, evolution of the CIM concept, CIM II, benefits of CIM. **Manufacturing: An Overview:** Standard industrial classifications. types of manufacturing - continuous of discrete manufacturing, variety and volume, raw material to final product. Needs of CIM hardware, CIM software, CIM workstations. (6)

FUNDAMENTALS OF COMMUNICATIONS: Introduction, information: types of communications. Fundamentals of computer communications, representation of data, coding, transmission, medium, types of communication lines, communications hardware. Network architectures - the seven layers-OSI model, local area network (LAN), manufacturing automation protocol (MAP). Tools and techniques. **Database:** introduction, database management - user-database link, DBMS versus file manager, operation of DBMS. (6)

PRODUCT DESIGN: Needs of the market, design and engineering, the design process, computer-aided design (CAD), areas of application, benefits of CAD, computer graphics, CAD hardware and software, CAD/CAM workstations. Three-dimensional capabilities - principles of curve generation, representation of 3D surfaces, from CAD to CAM. Computer-aided engineering (CAE) - finite element technique. Transportability - proprietary formats, plot file formats, Kermit, standard formats-IGES, product definition exchange specification. Needs of CIM, CAD/CAM continuum, CAD-CAM link. Reverse engineering, simultaneous engineering. (7)

PRODUCTION PLANNING: Introduction, computer-aided cost estimating, production planning and control – MRP II, History Of Group Technology – role of G.T in CAD/CAM Integration – part families classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing. Process planning - role of Process, planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches. (7)

SHOP-FLOOR CONTROL: Data logging and acquisition - instrument interconnection standards. Automated data collection - bar codes, optical character recognition, vision or image processing, radio frequency identification, magnetic identification, voice

technology, comparison. Control types - programmable logic controllers. Sensor technology - touch probes, fiber-optic sensors, sensor networking. FMS – components of FMS – types – FMS workstation – material handling and storage system –FMS layout-computer control systems – applications and benefits. (7)

ROBOTICS AND MATERIAL HANDLING: robotics - overview, programming, sensor-controlled robots. Automated guided vehicles (AGVs) - types and technology, control. AS/RS, palletization. **Quality:** introduction, modern concepts of quality, statistical quality control (SQC), statistical process control (SPC), process capability, machining-inspection continuum - DMIS as a CAD-CMM interface standard. Coordinate measuring machine (CMM). (6)

MANAGEMENT OF CIM: role of management in CIM, cost justification, expert systems, participative management, outlook. **PERSONNEL:** Impact of CIM on personnel, role of manufacturing engineers - CIM engineer and technologist, CIM technicians. Roles of institutions. (6)

Total = L: 45 = 45

TEXT BOOKS:

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing" , PHI Learning Private Limited, New Delhi, 2010.
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 2001.

REFERENCES:

1. Mikell. P. Groover and Emory Zimmers Jr.,"CAD/CAM", Prentice hall of India Pvt. Ltd., 1998.
2. Rao P N, CAD/CAM Principles and Applications", Tata McGraw Hill Publications, 2007.
3. Radhakrishnan P, Subramanyam S and Raju V, "CAD/CAM/CIM", New Age International, 2008

12M016 MANUFACTURE AND INSPECTION OF GEARS 3 0 0 3

INTRODUCTION TO GEARS: Types of gears-classification, application of gears, gearboxes, drawings for gears, gear production method an overview, types of blanks and blank preparation. (5)

PRODUCTION OF CYLINDRICAL GEARS: Procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shaping machines. (6)

PRODUCTION OF CONICAL GEARS: Production of straight bevel gears by bevel gear generator, duplex rotary cutter method, Gleason Reva cycle method, spiral and hybrid bevel gear generation. Description of machine, cutter and machine setting. (6)

GEAR MATERIAL SELECTION AND HARDENING METHODS: Properties of gear materials-non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high speed application. Selection of material for worm and wheel. Hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tuftriding, hardening defects . (6)

GEAR FINISHING METHODS: Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting. (5)

GEAR INSPECTION: Type of gear errors-gear quality standards and allowable limits-tooth thickness, base tangent length measurement, pitch error, radial run out, involute profile error measurements methods and analysis, composite error measurement, computerized gear inspection, gear failure reasons and remedies. (6)

MODERN GEAR PRODUCTION METHODS: Gear production by stamping, die casting, powder metal process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods, shear speed shaping, gear broaching, Gleayson G-TRAC – gear generation methods. (6)

ECONOMICAL AND QUALITY PRODUCTION OF GEARS: Gear production systems – batch production, gear production cells, lean and agile production practices, automobile gear and gear boxes, heavy engineering gear production, gear for instruments and appliances, process and cutter selection for quantity, cost and quality criteria. (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Watson, "Modern Gear Production", Pergamon Press, 1984.
2. HMT, "Production Technology", Tata McGraw Hill, New Delhi, 1992.
3. Joseph R. Davis,"Gear Materials, Properties, and Manufacture", ASM International, 2005

REFERENCES:

1. SAE, "Gear Design Manufacturing Inspection Manual", SAE, 1990.
2. Weck M., "Hand Book of Machine Tools", Technology & Sons, 1984.
3. Gear Technology", Magazine – Back Volumes.
4. Faydor L. Litvin, Alfonso Fuentes-Aznar, Ignacio Gonzãlez-Perez, and Kenichi Hayasaka, "Noncircular Gears: Design and Generation", Cambridge University Press, 2009

12M017 HYDRAULIC AND PNEUMATIC SYSTEMS 3 0 0 3

INTRODUCTION: Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulic fluids, comparison between hydraulics and pneumatics. (5)

ACTUATORS AND CONTROL VALVES: Actuators-types & constructional details, Pressure, flow and direction control valves – types & constructional details, seals (7)

HYDRAULIC SYSTEM DESIGN: Sizing of hydraulic system- power pack, conduits, actuators, valves, accumulators. Heat generation and estimation of losses. (6)

TYPICAL INDUSTRIAL APPLICATION OF HYDRAULIC SYSTEMS: deceleration circuit, regenerative circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits. (4)

PNEUMATIC SYSTEM DESIGN: Design of sequential multi actuator circuits Cascade method, Step counter method and Karnaugh Veitch Map method. Integration of start selection, start restriction, emergency stop modules with multi actuator systems. (10)

TYPICAL INDUSTRIAL APPLICATIONS OF PNEUMATIC SYSTEMS: Metal working, handling, clamping, counter and timer circuits. (4)

PROGRAMMABLE LOGIC CONTROLLERS: Construction, typical specification, programming methods and applications. (4)

ADVANCED TOPICS IN FLUID POWER ENGINEERING: Servo & Proportional valves- types and applications, Hydropneumatics (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Anthony Esposito, " Fluid Power with Application", Pearson Education (Singapore) Pte.Ltd, Delhi, India, 2003.
2. Srinivasan R, "Hydraulic and Pneumatic Controls", McGraw –Hill education(India) Pvt Ltd, 2010

REFERENCES:

1. Majumdar, S.R., "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw- Hill., New Delhi, 2003.
2. Werner Deppert and Kurt Stoll, "Pneumatic Controls : An Introduction to Principles", Vogel-Druck Wurzburg, Germany, 1975.
3. Peter Rohner, "Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples", The Macmillan Press Ltd., UK, 1979.

12M018 NON-TRADITIONAL MACHINING 3 0 0 3

INTRODUCTION: Technological and commercial need, classification, performance constraints, selection of NTM, hybrid processes. (3)

MECHANICAL MACHINING PROCESS: Abrasive jet machining, water jet machining, abrasive water jet machining, abrasive flow machining, magnetic abrasive finishing - process parameters, material removal rate, mechanism analysis, process capabilities, abrasive particle size, limitations and applications. (9)

ULTRASONIC MACHINING: Ultrasonic machining system, mechanics of cutting, process parameters, analysis, capability, grain growing model, grain hammering model, limitations and applications. (5)

THERMO ELECTRIC MACHINING PROCESS:

ELECTRO DISCHARGE MACHINING (EDM): Working principle, process parameters, process capabilities, components of system and its functions, analysis of RC circuit, power delivered to discharging circuit, current in discharge circuit, parametric relation for material removal rate and surface finish, gap cleaning, process characteristics, effect of various parameters on material removal rate, application and limitations, electrical discharge wire cutting, wire EDM machine, stratified wire, process characteristics, application and limitations. (7)

LASER BEAM MACHINING (LBM): Production of lasers, types of lasers, process characteristics, working principle, process parameters, process capabilities, components of system and its functions, limitations, application in drilling, cutting, marking and miscellaneous applications. (3)

PLASMA ARC MACHINING (PAM): Working principle, process parameters, process capabilities, components of system and its functions, various plasma arc torches, process capabilities, comparison with oxy fuel cutting, application and limitations. (4)

ELECTRON BEAM MACHINING (EBM): Working principle, process parameters, process capabilities, components of system and its functions, application and limitations. (3)

ELECTRO CHEMICAL AND CHEMICAL MACHINING PROCESSES: Working principle, components and functions, process parameters, limitations and applications - electro chemical machining, material removal rate and mechanism, inter electrode gap, zero feed rate, finite feed rate, maximum permissible feed rate, self regulation feature, effect of temperature, hydrogen bubbles,

anode shape prediction, cos θ method, tool design - chemical machining, masks, etchants. (8)

HYBRID PROCESSES: Introduction, working principle, equipment, process parameters, process capabilities and applications of electro chemical grinding (ECG), electrical discharge grinding (EDG), electro chemical discharge grinding (ECDG). (3)

Total = L: 45 = 45

TEXT BOOKS:
1. HMT, "Production Technology", Tata McGraw Hill, 1997.
2. Gary F Benidict, "Non Traditional Manufacturing Process", Marcel Dekker Inc, 1987.

REFERENCES:
1. Hassan Abdel and Gaward El-Hofy, "Advanced Machining Processes", McGraw Hill Publications, 2005.
2. Vijay K Jain, "Advanced Machining Processes", Allied Publications Private Limited, 2002.
3. Carl Sommer, "Non-traditional Machining Handbook", Advance Publishing Inc., 2000.
4. James Brown, "Advanced Machining Technology Handbook", McGraw Hill, 1998.
5. Pandey P C, "Modern Machining Process", Tata McGraw Hill Publications, 1996.
6. Amithaba Gosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press. Private Limited, 1985.
7. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-35.pdf

12M019 RAPID PROTOTYPING 3 0 0 3

INTRODUCTION: Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems. (4)

FUSED DEPOSITION MODELING: Principle, process parameters, path generation, applications (4)

SELECTIVE LASER SINTERING: Types of machines, principles of operation, process parameters, data preparation for SLS, applications. (4)

STEREOLITHOGRAPHY SYSTEMS: Principle, process parameters, process details, data preparation, data files and machine details, applications. (4)

LAMINATED OBJECT MANUFACTURING: Principle of operation, LOM materials, process details, applications. (2)

SOLID GROUND CURING: Principle of operation, machine details, applications. (2)

LASER ENGINEERED NET SHAPING (LENS): Net shaping development at Sandia National Lab. (2)

CONCEPT MODELERS: Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system. (4)

RAPID TOOLING: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite, 3D Keltool, etc., direct rapid tooling - direct AIM, quick cast process, copper polyamide, rapid tool, DMILS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling. (7)

SOFTWARE FOR RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools. (4)

RAPID MANUFACTURING PROCESS OPTIMIZATION: Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation. (3)

ALLIED PROCESSES: Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models. (5)

Total = L: 45 = 45

TEXT BOOKS:
1. Pham D T and Dimov S S, "Rapid Manufacturing", Verlag, 2001.
2. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME, 1996.

REFERENCES:
1. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2008.
2. FDM Maxum User Guide.
3. FDM 1650 User Guide.
4. Sinterstation 2500 plus System User Guide.
5. MK-Technology Gmbh. System User Guide.

12M020 FLEXIBLE MANUFACTURING SYSTEMS 3 0 0 3

INTRODUCTION: Definition of an FMS - types and configurations concepts - types of flexibility and performance measures. Functions of FMS host computer - FMS host and area controller function distribution. (5)

DEVELOPMENT AND IMPLEMENTATION OF AN FMS: Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps. Project management - equipment development - host system development - planning - hardware and software development. (6)

AUTOMATED MATERIAL HANDLING AND STORAGE: Functions - types - analysis of material handling equipments. Design of conveyor and AGV systems, storage system performance - AS/RS - carousel storage system - WIP storage system - interfacing handling storage with manufacturing. (6)

MODELLING AND ANALYSIS OF FMS: Types of analysis: queuing- single server, multiple servers, queue disciplines, markovian queing models. Simulation and petrinet modelling techniques. (6)

DISTRIBUTED NUMERICAL CONTROL AND PROGRAMMABLE CONTROLLERS: DNC system - communication between DNC computer and machine control unit - hierarchical processing of data in DNC system - features of DNC systems, PLC - control system architecture - elements of programmable controllers: languages, control system flowchart, comparison of programming methods. (6)

PROCESS PLANNING: Approaches to process planning, study of a typical process planning, manufacturing planning and control, overview of production control. (6)

RECONFIGURABLE MACHINES AND SYSTEMS: Challenges, enabling technologies for reconfiguration– system level design issues in RMS – reconfigurable machines. (5)

FMS RELATIONALE: Economic and technological justification for FMS – JIT, KANBAN, Poke Yoke. Tool management of FMS, typical case studies - future prospects. (5)

Total = L: 45 = 45

TEXT BOOKS:

1. Parrish D J, “Flexible Manufacturing”, Butter Worth Heinemann Ltd, Oxford, 1993.
2. Groover M P, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall India Pvt. Ltd, 2002.

REFERENCES:

1. Tien-Chien chang, Richard A Wysk, “An Introduction to Automated Process Planning Systems”, Prentice Hall, Inc., Englewood cliffs, New Jersey, 1985.
2. Considine D M and Considine G D, “Standard Handbook of Industrial Automation”, Chapman and Hall, London, 1986.
3. Viswanadham N and Narahari Y, “Performance Modeling of Automated Manufacturing Systems”,
4. Prentice Hall India Pvt. Ltd, 2005.
5. Ranky P G, “The Design and Operation of FMS”, IFS Pub. UK,1983.

THERMAL ENGINEERING

12M021 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

INTRODUCTION: Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types. (7)

DISCRETISATION: Finite difference method - forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods. (9)

INTRODUCTION TO GRID GENERATION: Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements, adaptive grids. (7)

CFD TECHNIQUES: Lax - Wendroff technique - MacCormack’s technique, relaxation technique. Artificial viscosity, ADI technique, pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting. (9)

TURBULENCE MODELING: Turbulence energy equation- one-equation model, the k-ω model, the k- ε model. (7)

CASE STUDIES: Solving practical problems such as heat exchangers, IC engines, electronic equipment cooling, and compressors using CFD packages. (6)

Total = L: 45 = 45

Project based lab sessions

- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

TEXT BOOKS:

1. John D Anderson, " Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New Delhi, 2010.
2. Muralidhar K. and Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publications, 2009.
3. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc., 2006.

REFERENCES:

1. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, London, 2010.
2. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", Pearson, 2008.
3. Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, "Computational Fluid Dynamics: A Practical Approach", Butterworth-Heinemann, 2007.
4. John C. Tannehill, Dale A. Anderson, Richard H. Pletcher, "Computational Fluid Mechanics And Heat Transfer", Taylor & Francis Group, 1997.
5. Frank M White, "Viscous Fluid Flow", Tata McGraw Hill Education Private Limited, 2011.

12M022 IC ENGINE DESIGN 3 0 0 3

I C ENGINES: Introduction - Design of engine based on vehicle characteristics–engine capacity, calculation of bore and stroke length-balancing and vibration -critical speed and damping. Study of mounting methods of IC engines (6)

FUEL SUPPLY AND IGNITION SYSTEM: Working principles of simple and modern carburetors with modifications for variable speed, load operation. Supercharging and turbo charging. MPFI system. Diesel fuel pumps and injector-working principle- CRDI system. Battery and coil, Magneto type systems. (5)

ENGINE LUBRICATION AND COOLING: Functions of a lubricating system; Types of lubrication systems; mist, wet sump and dry sump systems; properties of lubricating oil; engine performance and lubrication; necessity of engine cooling; disadvantages of over cooling. Cooling systems; air cooling, water cooling: radiators. (4)

TESTING AND PERFORMANCE: Testing of IC engines-basics engine measurements: dynamometer; air & fuel flow rate, constant speed and variable speed test, methods of estimating indicated power: Indicator diagram; Willan's line; Morse test, brake power, volumetric efficiency. Heat balance test. (4)

COMBUSTION ENGINEERING: Chemical reactions, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion- Normal and abnormal combustion process –knocking / detonation, Factors affecting knocking/detonation in SI and CI engines; Fuel ratings: Octane and Cetane numbers. (4)

ALTERNATE FUELS: Environmental pollution, Environment friendly fuels: bio fuels, Hydrogen fuel cell. (3)

PISTON: Introduction –calculation of gas forces– variation of gas forces. Design of piston – calculation of side thrust – piston pin, rings. (4)

CONNECTING ROD: Introduction–design principles, procedure, selection of cross section, materials, manufacturing process - heat treatment. (4)

CRANKSHAFT: Introduction, determination of primary and secondary forces– balancing forces, calculation of rotating mass, location of mass. Selection of materials and cross-section, manufacturing process, heat treatment (4)

VALVE ACTUATING MECHANISM: Design of valves – valve springs – tappet. Cam design-cam profile generation, cam shaft design. Rocker and rocker arm design considerations, materials, manufacturing process, heat treatments (4)

FLYWHEELS: Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel – stresses of rim flywheels, design of hubs and arms of flywheel, turning moment diagram (3)

Total = L: 45 = 45

TEXT BOOKS:

1. Heldt P M, " High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1996.
2. Lichty, "I.C. Engines", Kogakusha Co., Limited, Tokyo, 1986.
3. Joseph Shigley, Charles Mischke, Budynas Richard, Keith Nisbett, "Mechanical Engineering Design", Tata McGraw Hill Education, New Delhi, 2008

REFERENCES:

1. Giles J G, "Engine Design", Illiffee Books Ltd., London, 1968.
2. John Fenton, "Gasoline Engine analysis for CAD", MEP, London, 1986.

3. Robert L. Norton, “Machine Design: An Integrated Approach”, Pearson, 2000.

12M023 REFRIGERATION AND AIR CONDITIONING 3 0 0 3

REFRIGERATION: Definition, Methods and application, production of low temperature, Refrigerants - properties - selection of refrigerants, Alternate Refrigerants (4)

AIR REFRIGERATION: Introduction, Reversed Brayton cycle, simple, boot-strap and regenerative aircraft air conditioning system, performance calculation (5)

VAPOUR COMPRESSION REFRIGERATION: Single stage VCR cycle, Performance analysis for various operating conditions, use of P-h chart, Multi stage VCR cycle-Multi compressor, multi evaporator and cascade system (6)

VAPOUR ABSORPTION REFRIGERATION: Ammonia-water VAR system, Lithium bromide-water VAR system, Use of P-x-T and h-x-T chart, performance calculation, Steam jet refrigeration and solar refrigeration systems. (6)

AIR CONDITIONING: Properties of moist air, Psychrometry of air conditioning process, by pass factor, apparatus dew point, Grand and room sensible heat factor , Selection of inside and outside design condition, Effective temperature (6)

COOLING LOAD: Types of load, Estimation of cooling/heating load for a building- heat transmission through building, Solar radiation - infiltration - internal heat sources (sensible and latent),outside air and fresh air load, psychrometric calculation for cooling (6)

DUCT DESIGN AND AIR DISTRIBUTION: Dynamic and frictional pressure drop in ducts, Fan total pressure, methods of duct design, Fan characteristics in duct systems, Air conditioning systems control (6)

BALANCING OF COMPONENTS: Condensers-air cooled, water cooled and evaporative condensers. Selection. Evaporator – flooded, dry expansion, shell and tube and double pipe. Compressors – reciprocating, rotary and centrifugal types. Expansion devices, cooling towers. (6)

Total = L: 45 = 45

TEXT BOOKS:

1. W.F.Stocker and J.W.Jones, “Refrigeration & Air Conditioning”, McGraw-Hill Book Company, 1985.
2. Manohar Prasad, “Refrigeration and Air Conditioning”, New Age International Publishers, New Delhi, 2010.
3. Arora .C, “Refrigeration and Air Conditioning”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

REFERENCES:

1. Roy J Dossat, “Principles of Refrigeration” S I Version, Wiley Easten Limited, New Delhi, 1985
2. Arora .R.C., “Refrigeration and Air Conditioning”, PHI Learning Pvt. Ltd, New Delhi, 2011
3. Jones W.P., “Air Conditioning Engineering”, Butterworth-Heinemann, 1994.
4. Web and video material of NPTEL, Prof. Ramgopal, IIT Kharagpur.

12M024 BIOGAS ENGINEERING 3 0 0 3

INTRODUCTION: Bio-Energy. Overview of biogas technology. Technical status of biogas technology. Economic viability of biogas technology. Diffusion status of biogas technology in developing countries. Biogas technology scenario in India. (6)

MATERIALS FOR BIOMETHANATION AND PRODUCTS OF METHANATION: Biomass and its availability. Biodegradability. Raw materials for biogas production and their characteristics. Conversion principles. Fermented slurry as fertiliser. (6)

BIO-REACTORS: Types of bio-reactors- Constant pressure type reactors, Ganesh model, Pragathi model, Astra model, Jwala biogas plant, Batch digester, Manawat digester, German designs, plastic bag digesters, free fabricated steel/plastic digesters, Tunnel type digester, Maya Farms model, Large Farm biogas plants, Anaerobic Contact reactors, Anaerobic Filter reactors. (9)

DESIGN, SELECTION, CONSTRUCTION AND OPERATION OF BIOGAS PLANTS: Design of the digester. Design based on End Use requirements. Scaling of biogas plants - GTZ method - digester sizing for a given end use device efficiency. Optimal design - KVIC. Design of fixed Dome type of digesters. Material estimate for fixed dome plants. Selection of type and size of biogas reactors and their specifications. Constructional aspects. Operational problems in biogas plants methods of improving plant productivity. Measuring and test programs. (9)

PURIFICATION, SCRUBBING, COMPRESSION AND STORAGE OF BIOGAS: Properties of H_2S. Origin of H_2S in biogas plants. Effect of H_2S on biogas plant and devices. Determination of H_2S content in biogas. Methods for removing H_2S from biogas. Process techniques. Requirements of absorbent. Desulphurising apparatus. Operation procedures for desulphurization. Scrubbing, storage, transportation. (9)

UTILISATION SYSTEMS OF BIOGAS: Biogas as an alternative energy source. Biogas utilization. Biogas burners. Design of biogas burners. Stove models. Lighting mantles. Biogas using stationary power plants. Mobile power plants. Pollution control through anaerobic digestion. (6)

Total = L: 45 = 45

TEXT BOOKS:
1. Nijaguna B T, “Biogas Technology”, New Age International Publishers, New Delhi, 2002.
2. Khandelwal K C and Mahdi S S, “ Biogas Technology, Vol. I”, Tata McGraw Hill, 1986.
3. Frank Stephan, “Biogas Technology”, Fachhochschule Koln Hochschule, Bremerhaven, Germany, 1985.

REFERENCES:
1. Helmut Muche/Harald Zimmerman, “The Purification of Biogas”, Friedr Vieweg and Sohn, Germany, 1985.
2. Ludwig Sasse, “Biogas Plants”, Friedr Vieweg and Sohn, Germany, 1985.
3. Singh J B, Reymond Myles and Anil Dhussa, “Manual on Deenabandhu Biogas Plant”, Tata McGraw Hill, 1987.
4. Tata Energy Research Institute, “Fixed Dome Biogas Plants, A design, Construction and Operation Manual”, 1987.

12M025 AUTOMOBILE ENGINEERING 3 0 0 3

AUTOMOBILE ARCHITECTURE AND PERFORMANCE: Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance. (6)

ENGINE ARCHITECTURE AND PERFORMANCE: Types of engine, multi valve engine, in-line engine, vee-engine, Petrol engine-direct, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles, Engine Control Unit. (6)

TRANSMISSION SYSTEMS: Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling (10)

WHEEL AND TYRES: Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres. (6)

SUSPENSION SYSTEM: Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems. (6)
STEERING SYSTEM: Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing. (6)

BRAKING SYSTEM: Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes, anti lock braking system. (5)

Total = L: 45 = 45

TEXT BOOKS:
1. Gupta .R.B, "Automobile Engineering ", Satya Prakashan, 2009.
2. Kirpal Singh, “Automobile Engineering Vol-I & II”, Standard publishers, New Delhi, 2011.
3. Heinz Heisler, “Vehicle and Engine Technology”, SAE International and Elsevier, 1999.

REFERENCES:
1. Julian Happian Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann, New Delhi, 2002
2. Crouse W H, “Automotive Transmissions and Power trains”, McGraw Hill Book Co., New Delhi, 1976.

12M026 AUTOMOTIVE ELECTRONICS 3 0 0 3

AUTOMOTIVE ELECTRICALS AND ELECTRONICS: Basic electrical components and their operation in an automobile - starting systems - charging systems - ignition systems- electronic fuel control - environmental legislation for pollution - overview of vehicle electronic systems - power train subsystem - chasis subsystem - comfort and safety subsystems. (7)

INTRODUCTION TO EMBEDDED SYSTEMS: Embedded systems definition-components of embedded systems - microprocessor, classification of microprocessors, microcontrollers, and memory peripherals. Introduction to an embedded board (TMS470/ARM9 based) for hands on lab sessions (RISC processor based with standard peripherals/interfaces and I/OS). (8)

OPERATING SYSTEM IN EMBEDDED ENVIRONMENT: Introduction to OS - General purpose of OS, RTOS - Kernel - Pre-emptive and non-pre-emptive, scheduler, interrupt - interrupt latency and context switch latency - board support package - task, multi-tasking, task synchronization, inter-task communication - features of a typical embedded RTOS (µC/OS-II). (8)

INTEGRATE DEVELOPMENT ENVIRONMENT: Introduction to integrated development environment (IDE) - getting started, HW / SW configuration (boot service, host - target interaction) - booting reconfiguration - Managing IDE - target servers, agents, cross development, debugging - introduction to an IDE for lab board - RTOS, PC based debugger. (8)

EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS: Engine management systems - Gasoline/diesel systems, various

sensors used in system - vehicle safety system - electronic control of braking and traction - introduction to control elements and control methodology - electronic transmission control - body electronics - infotainment systems - navigation systems - system level tests - software calibration using engine and vehicle dynamometes - environmental tests for electronic control units. (10)

EMBEDDED SYSTEM COMMUNICATION PROTOCOLS: Introduction to control networking - communication protocols in embedded systems -SPI, I^2C, USB - vehicle communication protocols - introduction to CAN, LIN, FLEXRAY, MOST, KWP2000 - DETAILS OF CAN. (4)

Total = L: 45 = 45

TEXTBOOKS:

1. Denton T, "Automobile Electrical and Electronics Systems", Butterworth-Heinemann, 2004.
2. Nicholas Navit, "Automotive Embedded System Handbook", CRC Press, 2005.

REFERENCES:

1. "BOSCH Automotive Handbook" John Wiley and Sons Ltd., 2007.
2. Knowles D, "Automotive Electronic and Computer Controller Ignition Systems", Prentice Hall, 1988.
3. William T M, "Automotive Electronic Systems", Heinemann Ltd., London, 1978.
4. Joerg Schaeuffele and Thomas Zurawka, "Automotive Software Engineering- Principles, Processes, Methods and Tools", SAE, 2005.
5. Ronald K J, "Automotive Electronics Handbook", McGraw Hill Professional, 1999.
6. Jorg Schauffer, "Automotive Software Engineering", SAE, 2005.

12M027 ADVANCED FLUID DYNAMICS 3 0 0 3

INTRODUCTION: History of Fluid Mechanics, Properties of fluids – Viscosity, Compressibility, Stress in a fluid and Relation to Pressure (3)

FLUID KINEMATICS Velocity Field, Stream Lines, Streak Lines, Path Lines, Lagrangian and Eulerian Analysis, Control Mass and Control Volume Analysis, Integral and Differential Analysis – Definitions, Reynolds Transport Theorem, Material Derivative, Moving Control Volume. (3)

INTEGRAL ANALYSIS: Conservation of Mass, Conservation of Momentum, Conservation of Energy, First Law of Thermodynamics, Bernoulli's Equation, Derivation from Newton's law, Limitations, Second Law of Thermodynamics. (6)

DIFFERENTIAL ANALYSIS: Conservation of Mass, Conservation of Momentum, Conservation of Energy, Navier-Stokes Equation, Closed form solutions, Plane Poiseuille flow, Couette flow, Hagen-Poiseuille Flow, Darcy-Weisbach and Fanning friction factors, Frictional Loss, Modified Bernoulli equation, Moody Chart, Losses in pipe fittings Limitations of Closed Form Solutions, Concept of Boundary Layer & Inviscid Flow (8)

POTENTIAL FLOW: Bernoulli's Equation for Irrotational flow, Velocity Potential, Stream Function and Stream Lines Complex Potential for a flow, Cauchy Riemann Conditions, Basic Potential Flows, Circulation, Lift, Drag, Blasius Formula, Superposition of Potential Flows, D'Alembert paradox (4)

Boundary layer theory: Prandtl's boundary layer equations, Blasius solution, Karman-Pohlhausen Integral momentum equation, boundary layer separation and control, streamlined and bluff bodies -flow around circular bodies and aero foils, calculation of lift and drag (8)

TURBULENCE: Introduction, Derivation of Time Averaged Equations, Turbulence Models, Simple Analysis of the Turbulent Boundary Layer Velocity Profile (4)

INTRODUCTION TO GAS DYNAMICS: Mach Number and Compressibility, Isentropic Flow, Velocity of Sound and Pressure Disturbances, Subsonic and Supersonic Flows, Choking, Introduction to Shocks, Fanno Flows and Rayleigh flows (6)

Total = L: 45 = 45

TEXT BOOK:

1. Munson B R, Young D F and Okiishi T H, "Fundamentals of Fluid Mechanics", John Wiley & Sons, 2010

REFERENCES:

1. Currie I. G., "Fundamental Mechanics of Fluids", CRC Press, 2012.
2. H. Schlicting, K. Gersten, "Boundary Layer Theory", Springer, 2004.
3. Ascher H. Shapiro, National Committee for Fluid Mechanics Films, Cambridge, Massachusetts, February 1972.

INDUSTRIAL ENGINEERING

12M031 LEAN MANUFACTURING 3 0 0 3

INTRODUCTION: Origins and objectives of lean manufacturing- Lean process, 3M concept, key principles and implications of lean manufacturing- traditional Vs lean manufacturing characteristics – Road map for lean implementation and lean benefits. Study of Ford and Toyota production system, JIT manufacturing, Lean building blocks. (7)

LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination- seven types of waste- pull production- different models of pull production-The Kanban system-continuous flow- The continuous improvement process / Kaizen- Worker involvement. Design of kanban quantities, Leveled production, tools for continuous improvement. (7)

GROUP TECHNOLOGY AND CELLULAR LAYOUT: JIT with cell manufacturing - Part families- Production flow analysis – Composite part concept – Machine cell design -Quantitative analysis-case studies. Single piece flow (7)

VALUE STREAM MAPPING: The value stream – benefits, mapping process. The current state map – mapping icons, mapping steps. VSM exercises, Takt time calculations (7)

LEAN MANUFACTURING TOOLS AND METHODOLOGIES: Standardized work –standard work sequence, timing and work in progress. Quality at source - Autonomation/Jidoka, Visual management system, Mistake proofing/Poka-Yoke. 5S technique – Elements and waste elimination thro 5S, advantages and benefits, 5S audit. Visual control aids for improvement, Flexible work force (7)

TOTAL PRODUCTIVE MAINTENANCE: Goals and benefits – Hidden factory, the six big losses, types of maintenance, Overall equipment effectiveness, Pillars of TPM and implementation. Changeover and setup time reduction techniques. Temple of quality, OEE calculations. (7)

RECONCILING LEAN WITH OTHER SYSTEMS: Study of lean six sigma and lean design-lean and ERP-lean with ISO 9001: 2000, administrative lean. (3)

Total = L: 45 = 45

TEXTBOOKS:

1. Micheal Wader, “Lean Tools: A Pocket guide to Implementing Lean Practices”, Productivity and Quality Publishing,2002.
2. William M Feld, “Lean Manufacturing: Tools, Techniques and How to Use Them” , APICS, 2001
3. Dennis P Hobbs, “Lean Manufacturing Implementation”, Narosa publications, 2004

REFERENCES:

1. Richard B Chase “Production and Operations Management”, McGraw-Hill, 2003
2. Taiichi Ohno, “Toyoto Production Systems: Beyond Large Scale Production”, Productivity Press, 1988.
3. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons, 2003.
4. Mahadevan B, “Operations Management”, Pearson, 2010.
5. Gopalakrishnan N, “Simplified Lean Manufacture”, PHI Learning Pvt Ltd, 2010

12M032 VALUE ANALYSIS AND VALUE ENGINEERING 3 0 0 3

CONCEPTS: Introduction – status of VE in India and origin country – impact of VE application – types of values – types of function – function identification on product – function matrix – function analysis – elements of costs – calculation of costs – cost allocation to function – evaluation of worth in VE methodology. (11)

TECHNIQUES: General techniques: brain storming – godson feasibility ranking – morphological analysis – ABC analysis – probability approach – make or buy. Function – cost-worth analysis – function analysis – system techniques – function analysis matrix – customer oriented FAST diagram – fire alarm – Langrange plan – evaluation methods – matrix in evaluation – break even analysis. (11)

VALUE ENGINEERING IN JOB PLAN: Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase. (11)

CASE STUDIES: Water treatment plant – engineering management, pump component, motor component, wet grinder, automobile, hospital. (12)

Total = L: 45 = 45

TEXT BOOKS:

1. Mukhophadhyaya A K, “Value Engineering”, Sage Publications Pvt. Ltd., New Delhi, 2003.
2. Richard J Park, “Value Engineering – A plan for inventions”, St.Lucie Press, London, 1998.

REFERENCES:

1. Larry W Zimmesman. P E , “VE –A Practical approach for owners designers and contractors”, CBS Publishers, Delhi, 1992
2. Arthus E Mudge, “Value Engineering”, McGraw Hill book company, 1971

12M033 SUPPLY CHAIN MANAGEMENT 3 0 0 3

INTRODUCTION TO SUPPLY CHAIN MANAGEMENT: Definition, global optimization, objectives of SCM. Logistics networks- data collection, model and data evaluation, solution techniques. (7)

INVENTORY MANAGEMENT: Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting. (8)

VALUE OF INFORMATION: Bullwhip effect, information and supply chain technology. Supply chain integration- push, pull and push-pull system. Demand driven strategies, impact of internet on SCM, distribution strategies. (8)

STRATEGIC ALLIANCES: Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor-integration, procurement and out servicing strategies. (8)

INTERNATIONAL ISSUES IN SCM: Introduction, risks and advantages- design for logistics, supplies integration into to new product development, mass customization. Issues in customer value. (7)

INFORMATION TECHNOLOGY FOR SCM: Goals, standardization, infrastructure, DSS for supply chain management. (7)

Total = L: 45 = 45

TEXT BOOKS:

1. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, “Designing and Managing the Supply Chain”, Tata McGraw- Hill, New Delhi, 2003.

REFERENCES:

1. Chopra S and Meindl P, “Supply Chain Management: Strategy, Planning, and Operation”, Prentice Hall India Pvt. Ltd, New Delhi, 2007.
2. Robert B Handfield and Ernest L Nichols, “Introduction to Supply Chain Management”, Prentice Hall, Inc. New Delhi, 1999.
3. Sahay B S, “Supply Chain Management”, Macmillan Company, 2000.
4. David Brunt and David Taylor, “Manufacturing Operations and Supply Chain Management : The Lean Approach”, Vikas Publishing House, New Delhi, 2001.
5. Hartmud Stadler and Christoph Kilger, “Supply Chain Management and Advanced Planning: Concepts, Models, Software”, Springer-Verlag, 2000.
6. David F Ross, “Introduction to E-Supply Chain Management”, CRC Press, 2003.

12M034 INDUSTRIAL DESIGN AND APPLIED ERGONOMICS 3 0 0 3

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. (6)

INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications. (6)

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. (6)

WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue. (6)

ENVIRONMENTAL CONDITIONS: Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. (6)

BIOMECHANICS : Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision. (5)

BIOTHERMODYNAMICS AND BIOENERGEITICS: Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress. (5)

HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA’s approach, virtual environments. (5)

Total = L: 45 = 45

TEXT BOOKS:
1. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

REFERENCES:
1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Mayall W H, “Industrial Design for Engineers”, London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.

12M035 OPTIMIZATION TECHNIQUES FOR ENGINEERING SYSTEMS 3 0 0 3

INTRODUCTION: Engineering applications, statement of an optimization problem, classification, formulation of optimization models with simple examples. (6)

NON- LINEAR PROGRAMMING: One dimensional minimization-elimination and interpolation methods – Fibonacci, Golden Section, Quadratic Interpolation Methods, unconstrained optimization-direct search – Univariate and Hooks and Jeeves Pattern Search Methods, Powell’s Method - descent methods – Steepest Descent and Newton Methods, Quasi-Newton methods. (7)

CONSTRAINED OPTIMIZATION: Lagrangean method and Khun-Tucker conditions, direct – Sequential Linear Programming and indirect methods – Penalty function method, design of machine elements for minimum cost and maximum output - optimum design of springs, shafts. Optimum design of gears and suspension systems (6)

NETWORK OPTIMIZATION MODELS: Terminology of Networks – The shortest route problem – The minimum spanning tree problem – The maximum flow problem – The minimum cost flow problem – The network simplex method. (7)

DYNAMIC PROGRAMMING: Multistage decision process, principle of optimality, algorithms, application to design. (7)

INTEGER PROGRAMMING: Algorithms and applications, Graphical method, the branch and bound technique. Gomery’s Method (6)

NON-TRADITIONAL OPTIMIZATION ALGORITHMS: Genetic algorithms- working principle, difference and similarities between GAs and traditional methods, GAs for constrained optimization. Neural network, simulated annealing approach-(introduction only). (6)

Total = L: 45 = 45

TEXT BOOKS:
1. Singiresu S Rao, “Engineering Optimization: Theory and Practice”, Wiley-Interscience, 1996.
2. Stephen G Nash and Sofer A, “Linear and Nonlinear Programming”, McGraw-Hill, 1996.

REFERENCES:
1. Kalyanmoy Deb, “Optimization for engineering design”, Prentice Hall, New Delhi, 2000.
2. Johnson Ray C, “Optimum Design for Mechanical elements”, John Wiley and Sons, New York, 1990.
3. Goldberg D E, “Genetic Algorithms Search, Optimization and Machine”, Barnen. Addison Wesley, New York, 1989.

12M036 QUALITY ENGINEERING 3 0 0 3

CONCEPT OF QUALITY ENGINEERING: Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. (7)

LOSS FUNCTION: Derivation – loss function for products/system- justification of improvements- loss function and inspection- quality evaluations and tolerances-N type, S type, L type. (7)

ON-LINE QUALITY CONTROL: On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. (7)

On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems- measurement error and process control parameters. (6)

ON-LINE QUALITY CONTROL ATTRIBUTES CHARACTERISTICS: Checking intervals- frequency of process diagnosis. (6)

ON-LINE QUALITY CONTROL METHODS FOR PROCESS IMPROVEMENTS: Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods. (6)

QUALITY ENGINEERING AND TPM: Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems. (6)

Total = L: 45 = 45

TEXT BOOKS:
1. De Feo J A and Barnard W W, “Six Sigma: Breaktrough and Beyond”, Tata McGraw-Hill, New Delhi, 2005.
2. Pyzdek T and Berger R W, “Quality Engineering Handbook”, Tata-McGraw Hill, New Delhi, 1996.

REFERENCES:
1. Kaniska Bedi, “Quality Management” Oxford University Press, Chennai, 2007.
2. Brue G, “Six Sigma for Managers”, Tata-McGraw Hill, New Delhi, Second reprint, 2002.
3. Taguchi G, Elsayed E A and Hsiang, T.C.,”Quality Engineering in Production Systems”, Mc-Graw-Hill Book company, Singapore, 1989.

12M037 PROJECT ENGINEERING 3 0 0 3

PROJECT FEASIBILITY: Marketing, technical, financial feasibilities, case studies, report preparation. (4)

PROJECT MANAGEMENT: Nature, scope, different phases of project – phased manufacturing plan (PMP), semi knock down (SKD), completely knock down (CKD), totally integrated project management techniques. (6)

METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES: Present worth comparison - equal, unequal lived assets - study period – assets with infinite life - capitalized cost, bond valuation. Equivalent uniform annual cost comparison – situations for EUAC - Rate of return comparisons IRR – MARR IRR misconceptions (7)

INTEREST AND TIME VALUE OF MONEY: Simple interest, compound interest, uniform series payments, interest factors, use of interest tables, nominal and effective interest rates, continuous compounding, uniform continuous payment- uniform gradient. (7)

PROJECT FEASIBILITY ANALYSIS: . Depreciation - reasons - depreciation accounts - causes of declining value - depreciation methods. Cost - volume - profit analysis: review of conventional approach - analysis with time value - linear - non-linear - multi product break even analysis. - review of project management - PERT - CPM - crashing - cost system. (7)

REPLACEMENT ANALYSIS: Items deteriorating with time and items that fail completely, not accounting for time value of money and with accounting for time value of money, replacement policy for new and old machine with infinite horizon, group replacement (7)

RISK ANALYSIS: Risk in economic analysis, measuring risk investment, risk profiles, decision trees, formulation of discounted decision tree, simulation. (7)

Total = L: 45 = 45

TEXT BOOKS:
1. James L Riggs, “Engineering Economics”, Tata McGraw Hill Book Co., New Delhi, 2004.
2. Prasanna Chandra, “Projects”, Tata McGraw Hill, New Delhi, 2002.

REFERENCES:
1. James L Pappas and Eugene F Brigham, “Managerial Economics”, Holt, Rinehaut and Winston Ltd., 1983.
2. Srinath L S, “PERT and CPM – Principles and Applications”, EWP, New Delhi, 1982.
3. Norman N Barish, “Economic Analysis for Engineering”, McGraw Hill Book Company, New York, 1978.R5. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

ONE CREDIT COURSES

12MK01 PROCESS ENGINEERING AND COSTING 1 0 0 1

PROCESS ENGINEERING: General Manufacturing process and its types, Selection of manufacturing process-size and dimensional accuracy. (4)

SELECTING AND PLANNING THE PROCESS OF MANUFACTURE: Fundamental rules of the manufacturing process, Basic design of the product, Influence of process engineering on product design, Rechecking specifications, how materials selected affects the process cost, using materials more economically, the material cost balance sheet, Process planning and its types. (6)

SELECTION OF PROPER TOOLING: Classification, sources of tooling, tool holders, work piece holders, molds, patterns, core boxes, dies and gages. Availability of equipment, Effects of process parameters on performance and economy. (5)

Total = L: 15 = 15

TEXT BOOK:
1. Donald F Eary and Gerald E Johnson, “Process Engineering for Manufacturing”, Prentice Hall, New Delhi, 2003.

REFERENCE:
1. Serope Kalpakjian and Seven R Schmid, “Manufacturing Processes for Engineering Materials” Pearson Education, New Delhi, 2000.

12MK02 STRATEGIC AND HUMAN RESOURCES MANAGEMENT 1 0 0 1

STRATEGIC HUMAN RESOURCES: Introduction, challenges in strategic HRM , managing work flows and conducting job analysis, planning/recruiting, recruiting/retaining, managing diversity (5)

HUMAN RESOURCES DEVELOPMENT APPROACHES: Performance management, self motivation, employee relations, rights and discipline, safety and health (5)

TRAINING AND DEVELOPING A COMPETITIVE WORKFORCE: Knowledge management practices, external and organizational environments, team building (5)

Total = L: 15 = 15

TEXT BOOK:
1. Randall S. Schuler, "Strategic Human Resource Management", John Wiley & Sons, New York, 2000

REFERENCE:
1. Gomez-mejia, Balkin and Cardy, "Managing Human Resources", Pearson Education, New Delhi, 2006.

12MK03 MEASUREMENT OF VIBRATION AND SOUND 1 0 0 1

INTRODUCTION: Fundamental of vibrations – undamped free vibrations - damped free vibrations - forced vibrations - Transient vibrations – Non-linear vibrations. (3)

MEASURE OF VIBRATION: Vibration instruments – Mechanical Exciters – Electrical exciters and Transducers – Frequency Analyzers – Free vibration Measurement using Impact hammer – vibration analyzers. (5)

MEASUREMENT OF SOUND : Nature of sound – sound pressure level – sound power level – sound intensity level – frequency – combining decibels – sound propagation – sound level meter (5)

CASE STUDIES IN VIBRATION (2)

Total = L: 15 = 15

TEXT BOOK:
1. Ramamurti .V "Mechanical Vibration Practice and Noise Control" Narosa Publishing House, 2005.
2. Grover.G. K "Mechanical Vibratinons" New Chand and Brothers, Roorkee, 2001.

REFERENCE:
1. Rao.J.S and Gupta.K "Introductory Course on Theory and Practice of Mechanical Vibrations" New Age International Pvt. Ltd.1994.
2. Singh.V. P "Mechanical Vibrations" Dhanpat Rai and Co.Private, Limited, New Delhi , 2000.
3. Rao.S.S "Mechanical Vibrations", Prentice Hall of India, New Delhi, 2004.

12MK04 CHALLENGES IN IMPLEMENTING LEAN MANUFACTURING 1 0 0 1

VALUE STREAM MAPPING: Sections of VSM - symbols of VSM- application of VSM for an industrial process. (2)

CONTINUAL IMPROVEMENT (KAIZEN): Understanding the current status of the industry -establish metrics - identifying the wastes - applying lean principles (PDCA) - measure productivity. (2)
FMEA: Applying the principles of FMEA- understand severity, detection and occurrence - develop FMEA based on process flow- prioritize the activities to reduce RPN (4)

CONTROL PLAN: Applying the principles of control plan (CP)- understand sections of CP - establish parameters driven by product and process- verification needed before start of process- constant monitoring for stability of process- reaction plan. (4)

ERROR PROOFING (POKA-YOKE) - Understanding error proofing Vs mistake proofing (MP) - when EP and MP should be applied- develop EP and MP for a process- cost implications (3)

Total = L: 15 = 15

TEXT BOOK:
1. Ruffa, Stephen A, "Going Lean: How the Best Companies Apply Lean Manufacturing Principles" , AMACOM, A division of American Association, Broadway, New York, 1995.

REFERENCES:
2. APQP Manual, Automotive Industry Action Group 2008

12MK05 COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER ANALYSIS OF MECHANICAL SYSTEMS 1 0 0 1

INTRODUCTION: Basic concepts of fluid mechanics, Properties of fluids, Classification of fluid flow, Basic of heat transfer – conduction, convection and radiation, steady state diffusion, convection-diffusion, Introduction to CFD (3)

GOVERNING EQUATIONS: Application of physical principles, Deriving governing equations in conservation form- Continuity, Momentum and Energy equation, Classification of equations in PDE form. (4)

DISCRETIZATION: Discretization, Grid types, Finite Difference Method - forward, central, backward difference, Truncation error, Stability, Convergency, Consistency, Implicit and explicit method, Boundary conditions. (4)

CASE STUDIES: Solving practical fluid flow and heat transfer problems such as compressor, IC engine, pumps, and gear boxes analytically and using CFD software. (4)

Total = L: 15 = 15

TEXT BOOKS:

1. John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw-Hill, New Delhi, 2005
2. Muralithar K, Soundararajan.T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, 2003

REFERENCES:

1. Chung.T.J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002
2. John C Tannehill et al, "Computational Fluid Dynamics and Heat Transfer", Taylor and Francis, 1997

12MK06 THERMAL ANALYSIS OF MECHANICAL SYSTEMS USING FINITE ELEMENT METHOD 1 0 0 1

INTRODUCTION: Introduction to heat transfer- heat flow, conduction, convection, radiation, Importance of temperature gradient. (3)

FINITE ELEMENT METHOD: Concept of finite element method, Basic differential equation of heat transfer, Finite element formulation of governing equation. (3)

HEAT TRANSFER ANALYSIS: Steady state one dimensional heat flow-conduction, Steady state two dimensional steady state heat transfer involving conduction and convection. (3)

TRANSIENT HEAT TRANSFER ANALYSIS: One and two dimensional heat transfer involving conduction and convection (2)

CASE STUDIES: Solving practical problem using software. (4)

Total = L: 15 = 15

TEXT BOOK:

1. Chandrupatla Tirupathi, "Finite Element Analysis for Engineering and Technology", University Press, 2003.
2. Robert D. Cook, "Concepts and Applications of Finite Element Analysis", Wiley India Private Limited, 2007.

REFERENCES:

1. Daryl Logan, "First Course in the Finite Element Method", Nelson Engineering, 2007
2. Cengel, "Heat & Mass Transfer: A Practical Approach", Tata McGraw-Hill, 2009

12MK07 CREATIVE AND INNOVATIVE METHODS FOR DESIGN AND DEVELOPMENT 1 0 0 1

INTRODUCTION: Overview – The philosophy of designing process, product life cycle, organizations vs. organisms, Customer – logical, relational, comparative, Market – product driven, demand driven, Design problems – definition, alternatives, decision, solution. (2)

CREATIVITY: Definition, Need for creativity, Generating creative ideas – the seven Da-Vincian principles, Typology of idea generation activities, Principles of creativity, Creativity and serentipity. (3)

CREATIVITY TOOLS/TECHNIQUES: Use of creative techniques, Lateral thinking vs. breakthrough thinking, Nine creativity tools – brainstorming, morphological analysis, analogic approach, bio-mimicry, TRIZ, contra-think, serendipity, technology forecast, six thinking hats (3)

BRAINSTORMING AND TRIZ: Brainstorming – definition, steps to do brainstorming, evaluation of ideas, TRIZ – levels of invention, physical contradictions, Contradiction matrix – standard features and inventive principles, Evaluation of technical trends, S-field analysis. (4)

INNOVATIVE DESIGN: Design rules, Evaluation, Audit, and Innovative design case studies. (3)

Total = L: 15 = 15

TEXT BOOK:
1. Paul Trott, "Innovation Management and New Product Development", Pearson education, 2004
2. Brain Clegg," Creativity and Innovation for Managers", Butterworth Heinmann publishers, 2005

REFERENCES:
1. Gopalakrishnan.P.S, "Ideas, Creativity and Innovation: Keys to Survival", ICFAI university press, 2008
2. Srikant Surya Pala A, "TRIZ: A New Framework for Innovation Concepts and Cases", ICFAI university press, 2005

12MK08 CONCEPTS OF PRODUCT DESIGN 1 0 0 1

INTRODUCTION : Design briefing or product brief statement, Product Design Specification (PDS) and constraints vs. limits. (2)

SKILL SETS EVALUATION: Sketching skills and other skill sets evaluation, Design documentation (1)

CONCEPT DESIGN: Definition, Concept design, Concept generation and evaluation (4)

DETAILED DESIGN: Design factors – manufacture, sales, purchase, cost, transport, and disposal. (2)

ERGONOMICS AND ANTHROPOMETRICS (2)

DESIGN PROCESS: Material selection, Manufacture, Marketing and evaluation of the final design. (4)

Total = L: 15 = 15

TEXT BOOK:
1. Karl T Ulrich, Steven D Eppinger, Anita Goyal, "Product Design and Development", Tata McGraw-Hill, 2009.
2. Mike Ashby, Kara Johnson, "Materials and Design: The Art and Science of Material Selection in Product Design", Butterworth Heinemann, 2009.

REFERENCES:
1. Chitale.A.K, Gupta.R.C, "Product Design and Manufacturing", Prentice Hall Of India, 2009.
2. Lal.G.K, Vijay Gupta, Venkata Reddy.N, "Fundamentals of Design and Manufacturing", Narosa Book Distributors Private Limited, 2010.

12MK09 COOLING OF ELECTRONIC EQUIPMENT 1 0 0 1

INTRODUCTION TO ELECTRONICS COOLING: Needs, Goals, Levels. Fundamentals of heat transfer: Extended surfaces, contact resistance. (4)

AIR FLOW MANAGEMENT: Fan characteristics, System characteristics, Fan performance (2)

HEAT ANALYSIS: System level analysis, Board level analysis, and package level thermal analysis. Heat sink technologies: air cooled components and boards, experimental methods. (2)

HEAT EXCHANGES AND COLD PLATES: Thermal design process, analytical techniques, thermal design of multi-chip module. (2)

HEAT SINK DESIGN AND OPTIMIZATION: Free convection, liquid cooling, advanced cooling. (2)

NUMERICAL METHODS: Case studies. (2)

Total = L: 15 = 15

TEXT BOOK:
1. Incropera.F.P and DeWitt.D.P, "Fundamentals of Heat Transfer", John Wiley and Sons, 1985.
2. Steinberg.D.S "Cooling Techniques for Electronic Equipment", John Wiley and Sons, 1990.

REFERENCES:

1. Lian- Tuu Yeh, Richard C Chu and Dereje Agonafer, "Thermal Management of Microelectronic Equipment: Heat Transfer Theory, Analysis Methods and Design Practices", 2002.
2. Tony Kordyban, "Hot Air Rises and Heat Sinks: Everything You Know about Cooling Electronics is Wrong", 1998.

12MK10 VALUE ANALYSIS AND VALUE ENGINEERING 1 0 0 1

OVERVIEW: Meaning of Value engineering(VE), Difference from other initiatives, Value and its types, Relationship between value vis-à-vis person, time and environment, History of Value engineering/Value analysis/Value management, World bodies of Value engineering & their activities, Multi-disciplinary team approach in Value engineering study (1)

VALUE ENGINEERING JOB PLAN: Intoduction, comparison of job plans of various value engineering authorities, components of VE job plan (1)

ORIENTATION PHASE: training associates in Value Analysis and Value Engineering (VAVE), different trainings and certifications available in VAVE, Method to conduct VAVE studies (1)

INFORMATION PHASE: information needed for VAVE, Method to collect and analyze information, ABC Analysis, Pareto Analysis, Breakeven analysis (1)

FUNCTION ANALYSIS PHASE: Breakdown item into elements and sub-elements, questions to be asked, introduction to functions, practice session, types of functions (use and sell function), levels of function (basic and secondary), identify various functions, elements of cost, procedure for cost allocation, cost allocation to function, concept of worth, process flow for determining Worth, discussions on Worth, meaning of FAST, use of FAST, development history of FAST, different types of FAST. Ground rules of FAST, FAST diagram. (4)

CREATIVE PHASE: Definition of creativity, misconceptions about creativity, introduction to creative techniques like TRIZ, 3P, lateral adoption and others (3)

EVALUATION PHASE: Selection of criteria, feasibility analysis, weighted evaluation methods, decision matrix (1)

RECOMMENDATION PHASE: Need for recommendation, method to make presentation, impact analysis and justification report, implementation plan, presentation skills. (1)

IMPLEMENTATION PHASE: Detailed design, verification and validation, certification, change implementation. (1)

AUDIT PHASE: Need for audit, types of audit, how to do audit. (1)

Total = L: 15 = 15

TEXT BOOK:

1. Iyer.S.S, “Value Engineering - A How to Manual”, New Age Publishers, Chennai, 2006.

REFERENCES:

1. Mukhophadhyaya A K, “Value Engineering”, Sage Publications Private Limited, New Delhi, 2003.

LANGUAGE ELECTIVES

12M080 PROFESSIONAL ENGLISH

3 0 0 3

COMMUNICATION SKILLS USING LITERARY TEXTS: Comprehension and critical evaluation of literary essays – focus on language style, vocabulary, variety of expression, and emphasis techniques – review of short stories – critical appreciation of poetry - review of a novel. (12)

ESSENTIALS OF PROFESSIONAL COMMUNICATION: Intra and interpersonal communication, interview techniques, group communication, public speaking, and Presentation techniques - style and writing techniques, email writing, and cross – cultural communication. (10)

FOCUS ON SOFT SKILLS: Etiquette, body language, telephone conversation, and team building. (4)

REPORT WRITING: Format and different types of formal reports, memos, and proposals. (5)

PROFESSIONAL SKILLS: Presentations and reviews – group discussions – mock interviews, and case studies. (14)

Total L:45

TEXT BOOK:

1. Monograph prepared by the Faculty, Department of English, in 2012.

REFERENCES:

1.Dhanavel, S.P., "English and Soft Skills", Orient BlackSwan, Hyderabad, 2010.
2.Murphy, Herta A, Hildelrandt, Herbert W and Thomas, Jane P, "Effective Business Communication", Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 2008.
3.Sharma, C.M. Ed., "Twelve Short Stories: An Anthology of Short Stories", Oxford University Press, New Delhi, 2001.
4.Amitav Ghosh, "River of Smoke", Penguin India, New Delhi, 2011.
5.Priyadarshi Patnaik, "Group Discussion and Interview Skills", Indian Institute of Technology, Kharagpur, 2011.

12M081 BASIC GERMAN

3 0 0 3

INTRODUCTION: German culture, tradition, universities and companies, alphabet, greetings, vocabulary. (3)

GRAMMAR: Pronouns, verbs (sein and haben) and their conjugations, articles, question words, statements and questions, negation, countries, nationalities and languages, simple dialogues. (7)

USAGE OF NOUNS and ADJECTIVES: Singular and plural, possessive pronouns, family, professions, number system, a short text and dialogues related to family - exercises. (8)

IRREGULAR VERBS: Subject – verb agreement (with regular and irregular verbs), accusative and dative declensions of pronouns and articles, modal verbs and their related grammatical structure. (4)

SYNTAX: Word order and sentence formation, usage of nicht/kein, usage of modal verbs and dialogues. (4)

TIME: Formal and informal expressions, usage of adverbs, daily routines, related verbs and question words, related vocabulary and grammar, sample dialogues and exercises. (8)

Invitations and telephone conversations. (2)

SKILLS TRAINING: Listening, speaking, reading, and writing . (9)

Total L: 45

TEXT BOOKS:

1. Rosa-Maria Dallapiazza, Eduard von Jan and Til Schönherr , " Tangram aktuell 1" Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2006.
2. Hermann Funk, Christina Kuhn and Silke Demme, " studio d A1", Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2009.

REFERENCES:

1. Mukhopadhyay, Ajayita, " Viva üben macht Spaβ-2", Viva Education Pvt. Ltd., New Delhi, 2008.
2. Mukhopadhyay, Ajayita, " Viva üben macht Spaβ-3", Viva Education Pvt. Ltd., New Delhi, 2008.
3. Kursisa, Anta et al., "Fit für fit in Deutsch 1 und 2", Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2010.

12M082 BASIC FRENCH

3 0 0 3

INTRODUCTION: French Culture and Civilization, Grammar and Vocabulary. (2)

UNIT-1: Getting to know - and invite responses to the call - describe people-definite and indefinite articles - kind of nouns and adjectives, negation and interrogation - the present conjugation - paris monuments and public places - the lives of four different parisian professions. (11)

UNIT-2: Expressing the order and the obligation to request and order - evaluate and appreciate, congratulate and thank - partitive articles, demonstrative adjectives and possessive prepositions and adverbs of quantity and imperative of reflexive verbs - a region of france burgundy - daily life in the countryside. (11)

UNIT-3: Telling and reporting - advise - complain and reprimand - explain and justify - pronouns-near future - past tense and imperfect tense - several regions of france - different social worlds. (11)

UNIT-4: Ask for permission - prohibition - make projects - discuss and debate -pronouns <en> and <y> - relative pronouns and

superlatives - conjugation of the future - past and present continuous récent - the regional administrative life - economic and ecological problems - tradition and modernity. (10)

Total L:45

TEXT BOOK:

1. Philippe Dominique, et al., "Le Nouveau Sans Frontières", CLE International, 1999.

REFERENCES :

1. Mathurin Dondo, "Dondo Modern French Course ", Oxford University Press, Great Britain, 1997.
2. Margaret Lang and Isabelle Perez, "Modern French Grammar", Paris, 1996.

12M083 BASIC JAPANESE

3 0 0 3

INTRODUCTION: Geographic and socio - economic perspective to japan, japanese people and culture basic greetings and response, script, method of writing hiragana and katakana, combination sounds and simple words. (5)

GRAMMAR: Fundamental structure of sentences – particles and particle phrases, affirmation, negation, interrogation, self introduction, demonstratives, place markers, numerals and sentences in polite speech. (10)

VERBS: Past and non past tense, polite form of verbs and their uses - interactive functions of different verb forms, expressions of time-days of the week, month and time of the day, conversation related to customs, habits and completion of action. (10)

NOUNS AND ADJECTIVES: Types of adjectives, combination of noun with `i` and `na` adjectives, negation and past forms of adjectives - uses of noun and adjective sentences, existence of things/persons/animals/etc., positional nouns. (9)

ADVANCED EXPRESSIONS: Expressions of abilities, likes, dislikes, skills, need, desire etc., expressions of giving and receiving, comparisons and reasoning, expressing counters of different objects. (6)

SKILLS TRAINING: Writing (basic structure of kanjis), listening, speaking, origami, method of using chopsticks. (5)

Total L: 45

TEXT BOOK:

1. Minna no Nohongo – Romaji ban, 3A Corporation, Tokyo, 2000.

REFERENCE:

1. Minna no Nihong- I, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2007.

OTHER DEPARTMENT ELECTIVES

COMPUTER SCIENCE ELECTIVES

12M090 DATABASE MANAGEMENT SYSTEM 3 0 0 3

BASIC CONCEPTS: Introduction to databases – Conventional file Processing – Data Modeling for a database – Three level architecture – Data Independence – Components of a Database management System (DBMS) – Advantages and disadvantages of a DBMS. (6)

DATA MODELING: Introduction – Data Associations – entities, attributes, relationships – Entity relationship data models (ERD) – Generalization – Aggregation – Conversion of ERD into tables – applications – Introduction to Network data model and Hierarchical data model. (7)

FILE ORGANIZATION: Storage device Characteristics – Constituents of a file – Serial Files – Sequential Files – Index Sequential Files – Direct Files –Secondary Key Retrieval – Indexing using Tree Structures. (6)

RELATIONAL MODEL: Introduction - Relational databases – Relational algebra - Relational Algebra queries - Relational Calculus: Tuple Relational calculus, Domain relational calculus – Queries in Relational calculus. (6)

RELATIONAL DATABASE MANIPULATION: Structured Query Language (SQL) – Basic Data Retrieval - Condition specification – SQL Join – views and update. (7)

DATA BASE DESIGN THEORY: Functional dependencies - Axioms – Normal forms based on primary keys – Second Normal form, Third Normal form, Boyce – Codd Normal form – Examples – Multi-valued dependencies – Fourth Normal form – Data base design process – Database Tuning. (7)

DATABASE SECURITY, INTEGRITY CONTROL: Security and Integrity threats – Defense mechanisms Distributed – Database (6)

Total = L: 45 = 45

TEXT BOOKS:

1. Silberschatz. A., Korth H and Sudarshan S., “Database System Concepts”, McGraw Hill, 2002.
2. Elmasri R and Navathe.S.B, “Fundamentals of Database Systems”, Pearson Education, 2004.
3. Raghu Ramakrishnan and Johannes Gehrke, “Database Management System”, McGraw Hill, 2004.

REFERENCE:

1. Thomas Condly, Carolyn Begg, “Database System”, Pearson Education, 2003.

12M091 ENTERPRISE COMPUTING 4 0 0 4

ENTERPRISE FOUNDATIONS: Enterprise Architectural overview - object oriented software development for enterprise - Component Based software development for enterprise. Java Enterprise System. (5)

ENTERPRISE DATA ENABLING : Enterprise Data - Basis of JDBC, Drivers, Connection, Statement, Result Set, Advanced JDBC features. (11)

DISTRIBUTED ENTERPRISE COMMUNICATIONS ENABLING: Distributed Enterprise Communications Basis – RMI Communication – CORBA communication – DCOM Communication. (11)

ASYNCHRONOUS COMMUNICATIONS : Java Message Service, Point to Point messaging, Publish Subscribe messaging, Java Script, AJAX. (11)

ENTERPRISE WEB ENABLING : Java Servlets – HTTP Servlet, Generic Servlet, Java Server pages – Elements of JSP page, JSTL, Frame Works - JavaServer Faces, Struts. (11)

MULTITIER ENTERPRISE COMPUTING: Java Beans, Enterprise Java Beans, Stateless Session Beans, Stateful Session Beans, Message Driven Beans, Entity, Java Persistent Query Language, Accessing EJB in web services. (11)

Total = L: 60 = 60

TEXTBOOKS:

1. Paul J Perrone, Venkata S R, Krishna R and Chayanti, " Building Java Enterprise Systems with J2EE", Techmedia, 2000.
2. George Reese, “ Database programming, with JDBC and Java" , O’Reiliy, 2000.
3. Dustin R Callaway - "Inside Servlets " Addison Wesley, 2001.

REFERENCES:

1. Bill Burke and Richard Monson Haefel, “Enterprise Java Beans 3.0” O’Reily, 2006.
2. Raghu R Kodali, Jonathan R Wetherbee and Peter Zadrozny, “Beginning EJB 3 Application Development”, 2007.
3. Kevin Mukhar, Chris Zelenak, James L Weaver and Jim Crume, “Beginning Java EE 5: From Novice to Professional”, Apress, 2006.
4. Kito D Mann, “JavaServer Faces in Action”, Manning, 2005.
5. Dave Crane, Eric Pascarello and Darren Jame, “Ajax in Action”, Manning , 2006.
6. Eric Jendrock, Jennifer Ball, Debbie Carson, Ian Evans, Scott Fordin and Kim Haase “ The Java EE 5 Tutorial ”, Addison Wesley, 2006.

12M092 DATA STRUCTURES 4 0 0 4

INTRODUCTION: Software Development process – Abstraction - Data structures - Abstract data Types - Primitive data structures - Analysis of algorithms - Best, worst and average case time complexities - notation. (6)

STRINGS: Implementation - operations - String applications. SETS: Operations on sets - implementation of sets. **RECORDS:** implementation of variant records. (8)

ARRAYS: Operations - implementation of one, two, three and multi dimensioned arrays – Sparse and dense matrices - Applications. (6)

STACKS: primitive operations - sequential implementation - Applications: Subroutine handling - Recursion – Expression Processing. (5)

QUEUES: Primitive operations - sequential implementation - Priority Queues - Dequeues - Applications: Image component labeling; Machine shop simulation. (6)

LISTS: Primitive Operations - Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists - Applications: Addition of Polynomials; Sparse Matrix representation and Operations. – Linked Stacks - Linked queues - Linked Priority queues - Dynamic Storage Management. (14)

TREES: Terminologies - implementation - BINARY TREE: Properties - sequential and linked representation - common binary tree operations - traversals - Expression trees - Infix, Postfix and Prefix expressions - Threaded trees - Tournament trees - Heaps, Max heap, Min heap - Applications: Huffman codes; Placement of signal boosters. (10)

TABLE: Introduction – Operations – Implementation – Hash table – Collision – Resolution handling. (5)

Total = L: 60 = 60

TEXTBOOKS:

1. Aaron M Tanenbaum, Moshe J Augenstein and Yedidyah Langsam, "Data structures using C and C++", Pearson Education, 2004.
2. Sahni Sartaj, "Data Structures, Algorithms and Applications in C++", Silicon Press, 2004.
3. Nell B Dale, “C++ Plus Data Structures”, Jones and Bartlett Publishers, 2003.

REFERENCES:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Addition Wesley, 2007.
2. Robert L Kruse, Bruce.P Leung and Clovin L Tondo, “Data Structures and Program Design in C”, Pearson Education, 2007.
3. Vijayalakshmi Pai.G.A, “Data Structures and Algorithms: Concepts Techniques and Applications”, Tata McGraw Hill, 2008.

MANAGEMENT ELECTIVES

12M095 FINANCIAL AND MANAGERIAL ACCOUNTING 3 0 0 3

Introduction	(3)
Financial Statements	(3)
Transactional Analysis	(3)
Current Assets	(3)
Property, Plant & Equipment	(3)
Liabilities	(3)
Owner’s Equity	(3)
Income Statement	(3)
Statement of Cash Flows	(3)
Fundamental Interpretations of Financial Statements	(3)
Financial Statement Analysis	(3)
Managerial Accounting	(3)
CVP Analysis	(3)
Budgets & Performance	(3)

Segments & Flexible Budget (3)

Total = L: 45 = 45

TEXT BOOK:

1. Marshall and McManus, "Accounting: What the Numbers Mean", shrink-wrapped with the student supplement: Study Outlines, Solutions to odd-numbered problems and Ready-Notes, Irwin/McGraw Hill Publishers, 2010.

REFERENCE:

1. http://highered.mcgraw-hill.com/sites/0072379006/

12M096 MANAGERIAL FINANCE 3 0 0 3

Overview; Managerial Finance, Taxes	(5)
Financial Statements and Analysis	(5)
Cash Flow and Financial Planning	(5)
Working Capital & Current Asset Management	(5)
Current Liabilities Management	(5)
Time Value of Money	(5)
Capital Budgeting & Cash Flows	(5)
Risk & Return	(5)
Interest Rates	(5)

Total = L: 45 = 45

TEXT BOOK:

1. Gitman and Lawrence.J, "Principals of Managerial Finance-Brief", Addition Wesley Longman Inc., 2003

REFERENCE:

1. http://finance.utoledo.edu/tutors.htm

12M097 APPLIED BUSINESS STATISTICS 3 0 0 3

Statistics, Data and Statistical thinking	(3)
Describing Sets of Data	(3)
Basic Probability Concepts	(3)
Discrete Random Variables	(3)
Continuous Random Variables	(3)
Sampling Distributions	(3)
Estimation with Confidence Interval, Single Sample	(3)
Hypothesis Testing, Single Sample	(3)
Inferences Based on Two Samples	(3)
Simple Linear Regression	(3)
Multiple Linear Regression	(5)
Analysis of Variance	(5)
Categorical Data Analysis	(5)

Total = L: 45 = 45

TEXT BOOK:

1. McClave, Benson and Sincich, "Statistics for Business and Economics", Prentice Hall, 2004

12M098 MARKETING SYSTEMS 3 0 0 3

Course contents

Introduction and Overview	(2)
Marketing: managing Profitable Customer Relationships	(2)
Company and Marketing Strategy	(2)
Marketing in the Digital Age	(2)
The Marketing Environment	(2)

Managing Marketing Information	(2)
Consumer Markets and Buyer Behaviour	(2)
Business Markets and Business Behaviour	(2)
Segmentation	(2)
Products, Services and Branding	(2)
New Product Development	(2)
Pricing Considerations	(2)
Pricing Strategies	(3)
Marketing Channels	(3)
Integrated Marketing Communications	(3)
Advertising, Public Relations	(3)
Personal Selling	(3)
The Global Marketplace	(3)
Forecasing	(3)
	Total = L: 45 = 45

TEXT BOOK:

1. Philip Kotler, Gary Armstrong, "Principles of Marketing", 14th Study Guide Edition, Prentice Hall, 2011.

12M099 ANALYSIS OF MANUFACTURING AND SERVICE SYSTEMS 3 0 0 3

Operations As a competitive weapon 3	(3)
Operations Strategy	(3)
Project Management	(3)
Managing Processes	(3)
Process Analysis	(3)
Process Performance and Quality	(3)
Constraint Management	(3)
Process Layout	(3)
Lean Systems	(3)
Supply Chain Strategy	(3)
Location	(3)
Inventory Management	(3)
Sales and Operations Planning	(3)
Resource Planning	(3)
Scheduling	(3)
	Total = L: 45 = 45

TEXT BOOK:

1. Lee J Krajewsi, Larry P Ritzman and Majon K Malhotra, "Operations Management – Processes and Value Chains", PHI Learning Private Limited, New Delhi, 2008.

HUMANITIES ONE CREDIT COURSES

12OK01 PERSONALITY DEVELOPMENT – "A CAREER COPING STRATEGY"

1 0 0 1

KNOWING ONESELF: Explore habits, attitudes, preferences and experience and tune them to suit the organizations, Become aware of strengths and weaknesses, talents and problems, emotions and ideas, Know your ambitions, goals and values, IQ,EQ & SQ. (5)

SELF MANAGEMENT: Time management, Ability to Socialize. (2)

INTEGRATED PERSONALITY DEVELOPMENT: Recognizing the growth of different dimensions of one's personality such as, Physical, Intellectual, Emotional, Moral, Social and Spiritual. (4)

PERSONAL COMPETENCES: Developing rapport, Listening skills, Developing tem spirit, Assertiveness and negotiation skills, Leadership Skills, Giving and receiving constructive Criticism, Positive thinking and creative thinking, Interview techniques and grooming. (4)

Total: 15

REFERENCES:

1. RajivK Mishra, "Personality Development", Rupa & Co., 2008.
2. Selvam S. K. P., "Personality Development", Aph Publishing Corporation, 2010.
3. Materials provided by Guest Speakers.

12OK02 STOCK MARKET OPERATIONS AND ON-LINE TRADING

1 0 0 1

FINANCIAL MARKETS: Types of investments, Characteristics of investments. (5)

STOCK EXCHANGES IN INDIA: BSE & NSE Trading, Computation of Index. (2)

DERIVATIVES: Call and Put Options Futures and Forward Contracts, Swaps. (3)

DEMAT ACCOUNT AND TRADING ACCOUNT ON-LINE TRADING: Order placing, Cancellation of order, Speculation. (5)

Total:15

REFERENCES:

1. Bhalla, "Investment Management", Sultan Chand Books in India, 2008.
2. MachuRaju, "Indian Financial Market", Vikas Publishing House, 2nd Edition, 2002.
3. Panday I. M., "Financial Management", Vikas Publishing House, 9th Edition, 2007.

12OK03 FINANCIAL ACCOUNTING AND COST ACCOUNTING FOR ENGINEERS

1 0 0 1

INTRODUCTION OF ACCOUNTING: Branches of Accounting – Types of Accounting Concepts and Conventions – Subsidiary Books. (3)

TRADING, PROFIT & LOSS ACCOUNT: Balance Sheet. (3)

COST ACCOUNTING: Concepts – Objectives – Methods of Costing. Cost Sheet – Elements of Cost – Cost Concepts – Classification – Cost Sheet. (3)

JOB ORDER COSTING: Features Objectives – Procedure – Job Cost Sheet. Activity Based Costing – Methodology – Applications (3)

CURRENT TRENDS IN ACCOUNTING: Annual Reports – Skill Application. (3)

Total: 15

REFERENCES:

1. Grewal T.S., "Double Entry Book-Keeping", Sultan Chand & Sons, 5th Edition.
2. Shukla, "Principles of Accounting", Sultan Chand & Sons, New Delhi, 2005.
3. Gaur & Narang, "Cost Accounting", Kalyani Publishing Co., Ltd., New Delhi, 2011.

12OK04 VALUES AND ETHICS AT WORK PLACE

1 0 0 1

HUMAN VALUES AND ETHOS: Meaning and Significance of Values – Sources of Individual Values - Value crisis in the Contemporary Indian Society –Moral and Ethical Values. (4)

APPLICATION OF VALUES: Relevance of Values in Management – Personal Values and Values at Work place – Values for Managers. *(2)*

WORK ETHICS: Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership – Ethical dilemma - *Case Study*. (4)

SHARED VALUES IN THE ORGANIZATION AND ITS IMPACT: Need to identify and share values – the Value Construct and How to Promote Shared Values. (2)

UNIVERSAL VALUES: Cross Cultural Values - Impact of Culture on Organizations and Managing Workforce Diversity. (3)

Total : 15

REFERENCES:

1 Tripathi A. N., "Human values" – New Age international Pvt. Ltd., New Delhi, 2002.
2 Murthy C.S.V., "Business Ethics", Himalaya Publishing House, 2007.
3 Jayshree Suresh, Raghavan B.S., "Professional Ethics", S. Chand & Company Ltd., New Delhi, 2005.
4 Nandagopal R. and Ajith Sankar RN., "Indian Ethos and Values in Management", McGraw Hill, New Delhi, 2010.
5 Kiran D. R., "Professional Ethics and Human Values", Tata McGraw Hill, New Delhi, 2007.
6 Proceedings of National Conference on Integrating values & Social Concerns with Technical Education, PSG College of Technology, 2010.

12OK05 INSURANCE & RISK MANAGEMENT

1 0 0 1

INTRODUCTION TO RISK MANAGEMENT: Risk in Our Society. (3)

INSURANCE AND RISK: Client Side – Components of the Costs of Risk. (3)

PRINCIPLES OF INSURANCE: Insurance Company Operations – Documents. (3)

MASS CONTROL: Insurance Intermediaries – Insurance Companies and their Role in Deducting Business / Role Risks. (3)

FINANCIAL RISKS: Shift of Risks – Risk Derivatives. (3)

Total: 15

REFERENCES:

1. George E Rejda, "Principles of Risk Management & Insurance", 11th Ed., 2010.
2. John Hull, "Risk Management & Financial Institution", 2012.
3. Alka Mittal & S. L. Gupta, "Principles of Insurance & Risk Management", 2006.

12OK06 EXPORT - IMPORT MANAGEMENT

1 0 0 1

INTRODUCTION: Export – Import Business – Preliminaries for starting Export – Import Business – Registration. (3)

EXPORT PROCEDURES: Obtaining an Export Licence – Export Credit Insurance – Procedures and Documentation. (3)

FOREIGN EXCHANGE: Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES: Import Policy – Licence - Procedure and Documentation. (3)

EXPORT INCENTIVES: Incentives – Institutional Support. (3)

Total:15

REFERENCES:

1. C. Ramagopal, "Export Import Procedures - Documentation and Logistics", New Age International.
2. "Inco terms Export Costing and Pricing with Case Studies Case Law and Exercises", Paras Ram Anupam Publications, Edt. 23, Rs 495.
3. Cherian and Parab, "Export Marketing", Himalaya Publishing House, New Delhi, 2008.
4. Rathod, Rathor and Jani, "International Marketing", Himalaya Publishing House, NewDelhi, 2008.
5. "Government of India: Export-Import Policy, procedures, etc.", (Volumes I, II and III) NewDelhi.
6. "Government of India: Handbook of Procedures, Import and Export Promotion", New Delhi.
7. Duty Drawback, "(with New Drawback Rates w.e.f. 1st October, 2011)", Nabhi's Board of Editors, 49th edition, October 2011, Rs.670.
8. "Duty Entitlement Pass Book Scheme (DEPB)", Nabhi's Board of Editors, 24th, September 2010, Rs.340.
9. "EXPORTERS Manual and Documentation with Free Complimentary book How to Export (OUT OF PRINT)", Nabhi's Board of Editors, 2009, Rs.695.
10. "How to Export 2012", Nabhi's Board of Editors, 19th Edition, August 2012, Rs 240.
11. "How to Import 2012", Nabhi's Board of Editors, 18th Edition, August 2012, Rs.190.
12. M I Mahajan, "Import Policy procedures and Documentation 2012-13", Edt. 7, Jain Book Publishers, Rs 650.

12OK07 CORPORATE COMMUNICATION

1 0 0 1

INTRODUCTION: Basics of Corporate Culture, Etiquette, Code governing manners and conduct, Personal Grooming, People relationship, Worthy goals/ideals. (3)

CORPORATE COMMUNICATION (ORAL): Communicating in Organizational Settings, Recognizing effective Communication, Mastering Listening and Nonverbal Communication Skills, Overcoming Barriers to Communication, Communicating in Teams and Cross, Culturally and Fine, Tuning Corporate Communication Skills. (4)

WRITTEN COMMUNICATION: Planning, Writing, and completing business messages, Writing messages for Electronic Media, Creating effective E-mail messages, Writing routine and positive and negative messages, Writing persuasive messages, Guidelines for writing Reports and proposals/Format and layout of Business Documents. (5)

PRESENTATION AND NEGOTIATION SKILLS. (3)

Total: 15

REFERENCES:

1. Herta A. Murphy, Hebert W. Hildebrandt, and Jane P. Thomas, "Effective Business Communication", McGraw – Hill, VII Edition, New Delhi, 2008.
2. Courtland L. Bove'e, John V. Thill, and Mukesh Chaturvedi, "Business Communication Today", Dorling Kindersley India (Pvt). Ltd., 2009.

12OK08 INTERPERSONAL SKILLS

1 0 0 1

INTRODUCTION: Process of Communication, Types of Communication, Barriers to Communication, Case studies. (2)

ORAL COMMUNICATION: Communication in the work place. (1)

Conversational Skills. (1)

Presentation Skills (1)

Interview Techniques (2)

Team Management Skills	(1)
Spoken English	(2)
Personality Development	(2)
Practicals	(3)

Total:15

REFERENCES:

1. Kitty O Locker and Stephen Kyo Kaczmarek, “Business Communication”, McGraw – Hill, III Edition, New York, 2008.
2. Ashraf Rizvi M., “Effective Technical Communication”, McGraw – Hill, New York, 2005.
3. Sasikumar V., Kiranmai Dutt P. , and Geetha Rajeevan, “Oral Communication Skills”, Cambridge University Press India Pvt. Ltd., New Delhi, 2009.

12OK09 SOFT SKILLS

1 0 0 1

SOFT SKILLS: Importance and types of soft skills, Hand skills Vs soft skills in the world of work. (2)

INTERPERSONAL SKILLS: Significance, Interpersonal Skills for Team building, Making small Talks. (1.5)

EMAIL ETIQUETTE: Do’s and Don’ts of Email drafting. (3)

NEGOTIATION SKILLS: The need and Significance of negotiation Skills in work contexts. (2)

CROSS CULTURAL COMMUNICATION: The need for Cross Cultural Communication in the global context, Understanding Cross Cultural Communication. (1.5)

CORPORATE COMMUNICATION: The Essence of Corporate Communication, Conversations in Transactional Situations, Discussions/Meetings/Team Skills, Social Grace, Attitude Building. (5)

Total: 15

REFERENCES:

1. E.H. McGrath, S.J. “Basic Managerial Skills for All” Prentice – Hall of India Private Limited, New Delhi , 2008.
2. Kumar E. Suresh. “Communication Skills & Soft Skills : An Integrated Approach”. Pearson Education India, 2011.
3. Herta A. Murphy, Hebert W. Hildebrand t, and Jane P. Thomas, “Effective Business Communication”, McGraw – Hill, VII Edition, New Delhi, 2008.
4. Courtland L. Bove’e, John V. Thill, and Mukesh Chaturvedi, “Business Communication Today”, Dorling Kindersley India (Pvt). Ltd., 2009.

12OK10 TECHNICAL WRITING

1 0 0 1

INTRODUCTION: Fundamentals of Technical Writing, Using multifarious resources, Collecting and Organizing information, Understanding Audience/Readers, Analyzing Source credibility. (4)

TECHNICAL WRITING: Use of Language, Punctuation and Mechanics, Pre-writing Techniques, Documentation, Manipulating Written material, Proof reading, Paraphrasing and Summarizing. (4)

REPORT WRITING: Types of Reports, Creating an outline for Project Reports, Drafting information verbally and visually, Handling Presentation Tools, MS Word/MS Power Point, Using the library and the Internet, Quoting Bibliographical references, Plagiarism.(5)

PRACTICAL: Spotting the Error, Rewriting a given document, Producing Oral Reports. (2)

Total : 15

REFERENCES:

1. Blake, Gary & Robert W. Bly. The Elements of Technical Writing: The essential guide to writing. NY: MacMillan, 1993. ISBN: 0-02-013085-6
2. Society for Technical Communication. *Technical Communication 38,* 4(1991). Special Issue: Collaborative Writing.
3. Tichy, Henrietta J. *Effective Writing For Engineers, Managers, Scientists.* New York: John Wiley, 1988.
4. Strunk, William, Jr., and White, E. B. *The Elements of Style.* New York: Macmillan, 1979.

12OK11 MEASUREMENTS FOR SCIENCE AND ENGINEERING WITH OPEN SOURCE TOOLS

1 0 0 1

BLOCK DIAGRAM OF THE EXPEYES PLATFORM AND ITS FUNCTIONAL DESCRIPTION: Fundamental building blocks of the ExpEYES user library in C and Python. ExpEYES Graphical User interface. Using the input and output terminals. Voltage current ratings and timing. Measuring voltage and current . Voltage and current sources. Studying waveforms- amplitude, frequency and time measurement. FFT analyser. (7)

PYTHON PROGRAMMING BASICS: Introduction to the MinGW IDE. Experiment development using Python or C. Temperature measurement using PT100 and LM35. Oscillatory motion. Cooling curves. Magnetic induction. Capacitor charge and discharge. LCR circuits. Optical measurements-light sensor for timing signals. Electrical conductivity of electrolytes . Ultrasonic sensors. (8)

Total = L: 15 = 15

REFERENCES:

1. Ajith kumar BP, ExpEYES User Manual , IUAC publications New Delhi, 2012
2. Ajith kumar BP , ExpEYES Junior User manual, IUAC publications New Delhi, 2012
3. Ajith kumar BP, ExpEYES Programmers manual, IUAC publications, New Delhi, 2012
4. Ajith Kumar B.P, Python for Education, IUAC publications New Delhi , 2010
5. Mark lutz, Learning Python, O'Reilly media, 2009, USA
6. WEB RESOURCES:
7. Versions 2012 of IUAC publications for expEYES available for download on-line under OGL at
8. IUAC official website www.iuac.res.in
9. System hardware and software source files and other resources available at ExpEYES official website http://expeyes.in
10. Python programming language official website www.python.org