

SEMESTER 1

08O101 CALCULUS AND ITS APPLICATIONS

3 2 0 4

BASIC CONCEPTS: Limits and Continuity, revision. (2)

MAXIMA AND MINIMA: Maxima and minima of two variables, Constrained maxima and minima- Lagrange multiplier method. (4)

INTEGRAL CALCULUS: Evaluation of multiple integrals, Change the order of integration, Application of multiple integrals to find area and volume- Applications to engineering problems. Beta and Gamma Integrals, evaluation of definite integrals in terms of Beta and Gamma functions. (8)

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER: Basic concepts, Geometrical meaning, Separable differential equations. Modeling; Separable equations. Exact differential equations, integrating factors, linear differential equations, Bernoulli equations, applications to engineering problems. (8)

LINEAR DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER: Homogeneous linear equations of second order and higher order equations with constant coefficients. Euler-Cauchy equation, Non-homogeneous equations, solution by variation parameter, applications to engineering problems. (10)

VECTOR CALCULUS: Differentiation of vectors, gradient, Divergence, Curl, Directional derivatives. Line, surface integrals- Statement of Green's, Gauss Divergence and Stoke's Theorems- Applications to engineering problems. (10)

Total 42

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 2004.
2. George B Thomas J R and Ross L Finney, "Calculus and Analytical Geometry", Addison Wesley, 2004.

REFERENCES:

1. Riely K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering", Cambridge University Press, 2002.
2. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", McGraw Hill Inc., 2003.

08M102 APPLIED PHYSICS

3 0 0 3

ULTRASONICS: Introduction. Production – magnetostriction effect, magnetostriction generator, inverse piezoelectric effect, piezoelectric generator. Ultrasonics detection, Properties, Cavitation. Industrial applications – drilling, welding, soldering and cleaning. Non Destructive Testing – pulse echo system, through transmission, resonance system. Medical application. (9)

LASER TECHNOLOGY: Introduction. Principle - spontaneous emission, stimulated emission, Population inversion. Pumping mechanisms. Types of lasers - He-Ne, CO₂, Nd:YAG, Excimer, Dye lasers, Semiconductor laser. Applications - Spectroscopic analysis of materials, lasers in microelectronics, drilling, welding, heat treatment, cutting, holography, defence and ranging. (9)

FIBER OPTICS AND SENSORS: Principle. Modes of propagation. Fabrication techniques – rod and tube method, crucible-crucible technique. Classification based on materials, refractive index profile, modes. Splicing. Losses in optical fiber. Light sources for fiber optics. Detectors. Fiber optical communication links. Fiber optic sensors - temperature, displacement, voltage and magnetic field measurement. (8)

QUANTUM PHYSICS AND MICROSCOPY: Development of quantum theory. Dual nature of matter and radiation - de Broglie wave length. Uncertainty principle. Schroedinger's equation-Time dependent, Time independent. Particle in a box. Limitations of optical microscopy. Electron microscope. Scanning electron microscope, Transmission electron microscope, Scanning Transmission Electron Microscope, applications. (8)

VACUUM SCIENCE AND TECHNOLOGY: Introduction. Concepts of vacuum- Throughput, Pumping speed, Effective pumping speed and Conductance. Types of pumps, working principle and construction of rotary pump, diffusion pump, turbo molecular pump. Operation of pressure gauges - pressure range, measurement of vacuum using Pirani and Penning gauges, merits and limitations. Working of a vacuum system. Applications and scope. (8)

Total 42

TEXT BOOKS:

1. Avadhanulu M N and Kshir Sagar P G, "A Text Book of Engineering Physics", S Chand and Company Ltd., New Delhi, 2007.
2. Rao V V, Ghosh T B and Chopra K L, "Vacuum Science and Technology", Allied Publishers Limited, New Delhi, 1998.

REFERENCES:

1. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007.

2. Kannan M D and Balusamy V, "Engineering Physics", Vikas Publishing House, New Delhi, 2003.
3. Palanisamy P K, "Engineering Physics", Scitech Publications, Chennai, 2002.
4. Ageov N, Zuev A I and Kokora A, "Laser and Electron Beam Materials Processing", Mir Publications, Moscow, 1998.

08M103 APPLIED CHEMISTRY I

3 0 0 3

REACTION KINETICS: Integrated rate Laws, elementary reactions, experimental methods for determining reaction rates, temperature dependence of reaction rates, theories of reaction rates, kinetics of complex reactions. Chain reactions, mechanism of combustion process, kinetics of combustion of hydrogen and hydrocarbons, flame travel. (10)

WATER: Hardness – determination (EDTA method). Softening – zeolite and demineralization processes. Boiler troubles and remedies – removal of oils and silica, internal conditioning. Treatment of water for municipal supply– break point chlorination, desalination by electro-dialysis and reverse osmosis. Water quality standards and parameters. BOD and COD- definitions, determination and significance. (10)

POLYMER AND PLASTICS: Classification, Molecular weight of polymer. Functionality of monomers, Polymerization reactions – chain, condensation, copolymerization and co-ordination polymerizations, Plastics – advantages and disadvantages. Thermo plastics and thermoset plastics, compounding of plastics, polymer processing by injection, extrusion and blow moulding techniques. synthetic rubbers – applications. Polymer composites, polymer alloys. Criteria for selection of polymers for different engineering applications. (10)

PRINCIPLES OF ELECTROCHEMISTRY: Origin of electrode potential – types of electrodes, standard hydrogen electrode, reference electrodes -calomel and silver/silver chloride, ion selective electrodes. emf series – measurement of emf. Free energy and emf, Nernst equation. irreversible processes – kinetic treatment - overpotential, activation, concentration and IR overpotential – practical significance. (8)

CHEMISTRY OF ADVANCED MATERIALS: Organic electronic material, solid oxide materials, shape memory alloys, nanomaterials, fullerenes, ceramics- cemented carbides. (4)

Total 42

TEXT BOOKS:

1. Atkins P, "The Elements of Physical Chemistry", Oxford University Press, New Delhi, 2001.
2. Jain P C and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2002.
3. Gopalan R, Venkappayya D and Nagarajan S, "Engineering Chemistry", Vikas Publishing House Pvt. Ltd., New Delhi, 1999.

REFERENCE:

1. Kumaravel M, Kaniappan K, Murugavel S C and Senthilkumaar S, "Engineering Chemistry", R. K. Publishers, Coimbatore, 2003.

08O104 COMMUNICATION SKILLS IN ENGLISH

3 0 2 4

READING: Reading Practice on a variety of subjects to develop Reading skills such as identifying main ideas and using contexts for vocabulary.(General and semi-technical articles from Newspapers and Science Magazines) (5)

WRITING: Fundamental Principles of clear writing – Style and tone in formal writing with Exercises. (5)

MECHANICS OF WRITING: Grammar in context- focus areas – Tenses, Prepositions, Modals, Adjectives, Transformation of sentences. (7)

TECHNICAL WRITING: Definition, Description, Instructions, and Writing Technical Papers. (4)

TRANSCODING: Interpreting Graphics and Writing coherent paragraphs. Writing for focus. (2)

MIND MAP: Organisation of Coherent Paragraphs and Essays (2)

Cloze test to improve vocabulary, syntax and reading skills (4)

Letter Writing and Short reports (3)

PRACTICALS:

SPEAKING: Practice in Speech Making Process –To develop Communicative Ability – Techniques for speaking fluently, using body language, developing fluency and confidence.

Short Speeches (5)

Group Discussions and Role-plays

Listening Activities (5)

TEXT BOOKS:

1. Teaching Material prepared by the Faculty, Department of English
2. Sankaranarayanan V, Sureshkumar S and Palanisamy, "Technical English for Engineering Students", PHI, 2008.

REFERENCES:

1. Rodney Huddleston and Geoffrey K Pullam, A Student's Introduction to English Grammar, Cambridge University Press, UK, 2005.
2. Bert Decker, "The Art of Communicating", Decker Communications, Inc., USA, 2004.
3. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practice", Oxford University Press, UK, 2004.
4. AjayRai, "Effective English for Engineers and Technologies: Reading, Writing and Speaking", Crest Publishing House, New Delhi, 2003.
5. Paul V Anderson, "Technical Communication: A Reader – Centered Approach", Asia Pvt. Ltd., Singapore, 2003.
6. Albert Joseph, "Writing Process 2000", Prentice Hall, New Jersey, 1996

08M205 CONCEPTS OF ENGINEERING DESIGN**3 0 0 3**

The purpose of this course is to introduce to the undergraduate student the fundamental principles of Engineering Design which is very important and relevant in the context of today's engineering professionals. The course will be generic and will not require specialized preparation or prerequisites.

ENGINEERING ENTERPRISE: Engineering profession, ethics in engineering, technological innovation. (2)

ENGINEERING DESIGN: Engineering design process, identification and analysis of needs, organisation of design concept, design methods, considerations in engineering design, design decisions, development of design. (5)

COMPETENCIES OF DESIGN ENGINEERS: Categorisation of knowledge, process and management, levels of competency. (2)

CREATIVITY IN ENGINEERING EDUCATION: Intrinsic creativity, fostering creativity, ten maxims of creativity in education. (2)

MATERIAL SELECTION: Process, sources, economics of material selection, relative material cost, weighted property index, material substitution - Case study. (4)

GEOMETRICAL PRODUCT SPECIFICATIONS: Study of mechanical assemblies, general tolerances as per ISO 2768 – mH statistical tolerancing of mechanical assemblies, dimensional chain analysis, design evaluation based on various parameters. (6)

RAPID PROTOTYPING AND VIRTUAL REALITY (2)

VIRTUAL INSTRUMENTATION: Introduction, the front panel, the block diagram, data acquisition, components of a DAQ system, DAQ hardware configuration, DAQ assistant, analog I/O, digital I/O, typical sensor interface examples. (4)

MECHANICAL FAILURE ANALYSIS AND QUALITY: A typical case study. Modelling and simulation, a design tool. (3)

ENGINEERING ECONOMICS: Economic design making, time value of money, depreciation, profitability of investments, break even analysis, cost evaluation. Element of cost, cost estimation, manufacturing costs, learning curve, pricing a product, life cycle costing. (4)

ENGINEERING OPTIMISATION: An overview of issues in optimization of engineering design problems, multifactor objective function, Woodson methods, design of an educational toy. (4)

LABORATORY EXERCISES: Acquiring data and communicating with an instrument, statistical visualization using MATLAB, interfacing using LabVIEW, virtual instrumentation based machine control design, smart camera, study of unbalance mod=e; Experiments on study of product component form design, fabrication and testing. (4)

Total 42**TEXT BOOKS:**

1. George E Dieter, "Engineering Design, A Materials and Processing Approach", McGraw Hill International Book Co., (62:744 DIE (148 532), 1983.
2. Morris Asimov, "Introduction to Design", Prentice Hall, (62:744 ASI 23501), 1962.

REFERENCES:

1. Hill Percy J, "The Science of Engineering Design", Holt, Reinhart and Winston Inc., (62:744 Hill) 1970.
2. Saeema Ahmed, "An Industrial Case Study: Identification of Competencies of Design Engineers", ASME, Journal of Mechanical Design, July 2007, Vol.129, pp.709- 716.
3. Brett F Robertson, Joachim Walther and David F Radcliffe, "Creativity and the use of CAD Tools: Lessons for Engineering Design Education from Industry", ASME, Journal of Mechanical Design, July 2007, Vol.129, pp.753-760.
4. Kazem Kazerounian and Stephany Foley, "Barriers to Creativity in Engineering Education: A Study of Instructors and Students Perceptions", ASME, Journal of Mechanical Design, July 2007, Vol.129, pp.761-768.
5. Zbigniew Humienny (Editor), "Geometrical Product Specifications Course for Technical Universities", Warsaw Bielsko, Biala Erlangen Huddersfield Tallinn Vienna, 2001.
6. Gary W Johnson, Richard Jennings, "Labview Graphical Programming: Practical Applications in Instrumentation", Mcgraw Hill,

- Inc, Third Edition, 2001.
- Jeffrey Travis, "Labview for Everyone", Prentice Hall Inc., Second Edition, 2002.
 - Daniel E Whitney, "Mechanical Assemblies: Design Manufacture and Role in Product Develop", Oxford University Press, 2004.

08M110 ENGINEERING GRAPHICS I

(Also common with 08A110)

2 0 3 3.5

INTRODUCTION: Introduction to Engineering Drawing. Bureau of Indian Standards (BIS), geometric constructions, principles of dimensioning, introduction to computer aided drawing, co-ordinate system and reference planes, commands. (10)

ORTHOGRAPHIC PROJECTION: Principles of orthographic projection-projection of points, straight lines, planes and solids. Orthographic projection of simple engineering components-missing view exercises. (8)

PICTORIAL PROJECTIONS: Principles of pictorial views, isometric view of simple engineering components. Free hand sketching of orthographic views from pictorial views. Free hand sketching of isometric views from given two or three views. (10)

Total 28

TEXT BOOKS:

- Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Publishers, 2007.
- VTU, "A Primer on Computer Aided Engineering Drawing" Belgaum, 2006.

REFERENCES:

- Kumar M S, "Engineering Graphics", D D Publications, Chennai, Ninth Edition, 2007.
- Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, New Delhi, 2003.
- PSG CAD/CAM Centre Laboratory Manual, AutoCAD Level I and II, 1997.
- Luzadder W J, "Fundamentals of Engineering Drawing", Prentice Hall Book Co., New York, 1998.

08M211 PHYSICS LABORATORY

(Also common with 08Y211/08P211/08A211)

**0 0 3 1.5
(Annual)**

- Young's modulus of a material-cantilever method.
- Magnetic hysteresis.
- Coefficient of thermal conductivity of bad conductor Disc method
- Coefficient of viscosity-Poiseuille's method
- Lattice Parameters-powder photographic method
- Measurement of temperature-thermistor
- Efficiency of solar cell
- Electrical conductivity of metal and Alloy-Carey Foster Bridge
- Demonstration of optical phenomena using He-Ne Laser
- Demonstration of determination of laser parameters.

REFERENCE:

- Laboratory Manual prepared by Department of Physics.

08M212 CHEMISTRY LABORATORY

(Also common with 08P212 / 08A212)

**0 0 3 1.5
(Annual)**

- Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of lubricating oils
- Determination of flash point, fire point, cloud and pour point of oils
- Determination of acid value, saponification number and iodine value of oils
- Proximate analysis of coal
- Determination of total, temporary, permanent, calcium and magnesium hardness of water
- Determination of chloride, sulphate and alkalinity of water
- Determination of corrosion rate of steel in acid media by weight loss method
- Determination of inhibitor efficiency on the corrosion rate of steel in acid media by weight loss method
- Anodizing of aluminium and determination of thickness of anodic film
- Electroplating of nickel and determination of cathode efficiency

Demo Experiments

- Glass transition temperature of polymers- DSC curves and discussion
- Analysis of a flue gas by Orsat's apparatus / Gas chromatography
- Determination of calorific value of a solid fuel by bomb calorimeter/ determination of calorific value of a gaseous fuel by Boy's gas calorimeter
- Preparation and testing of greases, gels, defoamers, cutting emulsions

REFERENCE:

1. Laboratory Manual prepared by Department of Chemistry

SEMESTER 2**08M105 PROBLEM SOLVING AND C PROGRAMMING****2 0 2 3**

INTRODUCTION TO PROBLEM SOLVING: Program development- Analyzing and Defining the Problem- Modular Design- Algorithm - Flow Chart. (4)

PROGRAMMING LANGUAGES: What is programming language-Types of programming language- Program Development Environment. (4)

C: The C character set – Identifiers and keywords – Data types – Constants – Variables – Arrays – Declarations – Expressions – Statements – Symbolic constants – Operators and expressions – Arithmetic operators – Unary operators – Relational and logical operators – Assignment operators – Conditional operators – Library functions – Data input and output functions. (7)

CONTROL STATEMENTS: While statement – Do While statement – For – Nested loops – if else – Switch – Break – continue – comma operator – go to statement – programs. (3)

FUNCTIONS: Defining a function – Accessing a function – Passing arguments to functions – Specifying arguments, data types – Function prototypes – Storage classes – auto – Static – Extern and register variables. (4)

ARRAYS: Defining an array – Processing array – Passing array to a function – Multi dimensional array – Array and strings. (4)

POINTERS: Declarations – Pointers to a function – Pointer and one dimensional arrays – Operating a pointer – Pointer and multi dimensional arrays – Arrays of pointers – Passing functions to other functions. (6)

STRUCTURES AND UNIONS: Definitions – Processing a structure – User defined data types – Structures and pointers – Passing structure to functions – Self referential structures. (3)

FILES: Open – Close – Process – Operations on a file. (3)

Preprocessor Directives - Command Line Arguments. (4)

Total 42**TEXT BOOKS:**

1. Kernighan B W and Ritchie D M, "C Programming Language (ANSI C)", Pearson Education, 1999.
2. Herbert Schildt, "C – The Complete Reference", McGraw Hill, 2001.
3. Michael Schneider G, Steven W, Weingart and David M Perlman, "An Introduction to Programming and Problem Solving with Pascal ", John Wiley and Sons, 1998.

REFERENCES:

1. Gottfried B, "Programming With C", Mc Graw Hill, 2004.
2. Deitel H M and Deitel P J, "C: How to Program", Pearson Education, 2001.

08M106 ENGINEERING MECHANICS**3 2 0 4**

STATICS OF PARTICLES: Forces – system of forces - concurrent forces in plane and space- resultant - problems involving the equilibrium of a particle-free body diagram-equilibrium of particle in space. (7)

STATICS OF RIGID BODIES IN TWO DIMENSIONS: Rigid bodies-two dimensional structure-moment of force about an axis-moment of a couple-equivalent system of coplanar forces-Rigid body in equilibrium-problems involving equilibrium of rigid body-types of supports-reactions of beams and frames. (6)

FRICTION: Laws of friction-coefficient of friction-problems involving dry friction- wedge and ladder friction. (4)

APPLICATION OF STATICS: Roof trusses-Method of joints, method of sections and Tension coefficient method. (5)

CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA: Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids. (6)

KINEMATICS OF PARTICLES: Introduction-plane, rectilinear motion-time dependent motion-rectangular coordinates-projectile motion. (5)

KINETICS OF PARTICLES: Equation of motion-rectilinear motion-Newton's II law – D'Alembert's principle- Energy - potential energy-kinetic energy-conservation of energy-work done by a force - work energy method (5)

IMPULSE AND MOMENTUM: Concept of conservation of momentum- Impulse-Momentum principle- Impact-Direct central impact-oblique central impact. (4)

Total 42

TEXT BOOKS:

1. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006.
2. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.

REFERENCES:

1. Bansal R K, "Engineering Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2. Bhavikatti S S, "Engineering Mechanics", New Age International Pvt. Ltd., New Delhi, 2003.
3. Young D H and Timashenko S, "Engineering Mechanics", Tata Mcgraw-Hill, Fourth Edition, 2006.
4. Jivan Khachane, Ruchi Shrivastava, "Engineering Mechanics: Statics and Dynamics", ANE Books, 2006.

08M202 MATERIALS SCIENCE

3 0 0 3

MAGNETIC PROPERTIES: Ferro and ferri magnetic materials – properties. Heisenberg and domain theory of ferromagnetism. Hysteresis. Curie-Weiss law. Hard and soft magnetic materials and their applications. Ferrite – structure preparation and properties. (8)

THERMAL PROPERTIES: Introduction - coefficient of thermal expansion, heat capacity, thermal conduction mechanisms, thermal stresses. Applications-bimetallic strip, thermal insulation, thermal shock resistance, tempered glass, ceramic - to - metal joints, cryogenic materials. (9)

COMPOSITES: Definition -function of matrix and reinforcement in composites -classification of composites based on reinforcement-types of composite materials - polymer, metallic and ceramic matrix composites (qualitative). Law of mixtures. Comparison with conventional materials. Applications in surgery, sports equipment. (8)

SEMICONDUCTING MATERIALS AND DEVICES: Elemental and compound semiconductors. Intrinsic and extrinsic semiconductors - properties. Carrier concentration in intrinsic semiconductors. Carrier concentration in n-type and p-type semiconductors. Material preparation - Czochralski's technique and zone refining technique. Hall effect - Hall coefficient in extrinsic semiconductors, experimental determination of Hall coefficient. Application of Hall effect. Semiconductor devices – LDR, LED, Photodiode, Solar Cells and LCD. (9)

ADVANCED MATERIALS: Nanophase materials - Synthesis techniques, properties, applications. Shape Memory alloys (SMA) – characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA. Superconductivity. Types of superconductors - High T_c superconductors, comparison with low T_c superconductors. Application of superconductors. Metallic glasses – preparation, properties, applications. (8)

Total 42

TEXT BOOKS:

1. William D Callister Jr, "Materials Science and Engineering-An Introduction", John Wiley and Sons Inc., Sixth Edition, New York, 2007.
2. Shaffer J P, Saxena A, Antolovich S D, Sanders T H Jr and Warner S B, "The Science and Design of Engineering Materials", McGraw Hill Companies Inc., New York, 1999.

REFERENCES:

1. Jayakumar S, "Materials Science", R K Publishers, Coimbatore, 2006.
2. Robert Resnick and David Halliday, "Fundamentals of Physics", John Wiley and Sons Inc., New York, 2003.
3. Raghavan V, "Materials Science and Engineering - A First Course", Prentice Hall of India, New Delhi, 2001.
4. James F Shackelford S, "Introduction to Materials Science for Engineers", Third Edition, Macmillan Publishing Company, New York. 1992.

08M203 APPLIED CHEMISTRY II

(Also common with 08P203/ 08A203)

3 0 0 3

PETROLEUM PROCESSING: Distillation, stabilization, cracking, reforming, polymerization, alkylation's, isomerisation, cyclisation, aromatization, hydrogenation, purification, sweetening, sulphur removal, deasphalting, dewaxing. (4)

PROPERTIES AND TESTING OF PETROLEUM AND PETROLEUM PRODUCTS: Specific gravity, viscosity index, flash and fire points, cloud and pour points, smoke point and char value, sulphur content, ash content, calorific value. Fuel to match the engine - power output and fuel quality, spontaneous ignition temperature and hydrocarbon structure, knocking, grading of gasoline – octane

rating, gasoline improvers, diesel fuel, combustion stages, cetane rating, improvers, diesel index, antifreeze additives. (8)

COAL: Proximate analysis, coking. Calorific value- determinations, flue gas analysis– Orsats method. (4)

COMBUSTION CALCULATIONS: Theoretical air requirement, adiabatic flame temperature, calculations based on flue gas analysis. (4)

LUBRICATION AND LUBRICANTS: Lubrication - lubricating oils-petroleum fractions - dewaxing, testing of lubricating oils - viscosity index, oxidation resistance, carbon residue, neutralization number and other properties. Mechanism of lubrication, additives and improvers. Lubricating emulsions, gels and greases, synthetic lubricants, fluolubes-silicone lubricants, solid lubricants. (6)

CORROSION AND ITS CONTROL: Corrosion losses, mechanism of galvanic corrosion, differential oxygenation corrosion, Stress corrosion cracking, graphitization, fretting and cavitation, erosion. Factors influencing corrosion - oxidation potential, effect of over voltage, metal purity, physical state, relative anode and cathode area, relative volume of corrosion product, solubility of corrosion products, role of medium and presence of inhibitors. Corrosion control – sacrificial anode and impressed current methods, corrosion control at design stage. (8)

CELLS AND BATTERIES: Construction and working of Lechlanche cell, lead-acid battery, nickel-cadmium battery. Batteries for automobiles and UPS. Outline of fuel cells. (4)

ELECTROCHEMICAL PROCESS IN MECHANICAL ENGINEERING: Electropolishing, electrochemical machining-cutting, grinding, deburring and contour machining. Electrophoretic painting in automotive industry, technology of electropriming. (4)

Total 42

TEXT BOOKS:

1. Samir Sarkar, "Fuels and Combustion", Orient Longman, India, 1996.
2. Lyod Munrow, "Chemistry in Engineering", Third Edition, Queens, New Jersey, 1964.

REFERENCES:

1. Derek Pletcher and Frank C Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, London, 1993.
2. Gopalan Rao M and Marshall Sitting, "Outlines of Chemical Technology", Affiliated East-West Press Pvt. Ltd., New Delhi, 1973.
3. Kumaravel M, Kaniappan K, Murugavel S C and Senthilkumaar S, "Engineering Chemistry", RK Publishers, Coimbatore, 2003.

08M204 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. (4)

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

FLUID DYNAMICS: Statement of Navier Stokes equation, derivation of Euler's equation and Bernoulli's energy equation, examples illustrating the use of energy equations. (4)

FLOW MEASUREMENT: Orifice meter, venturi meter, flow nozzle, Pitot tubes, multi-hole probe and anemometer. (4)

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

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)

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. (6)

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

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

Total 42

TEXT BOOKS:

1. Kumar D S, "Fluid Mechanics and Fluid Power Engineering ", Kataria S K and Sons, New Delhi, 1997.
2. Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

REFERENCES:

1. Streeter Wylie and Bedford, "Fluid Mechanics", McGraw- Hill Publishing Company Limited, New York, 1998.
2. Irving H Shames, "Mechanics of Fluids", Third Edition, McGraw Hill Inc., New York, 1992.
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 Delhi, 1995.
5. King R P, "Introduction to Practical Fluid Flow (With CD)", Butterworth, 2002.

08M213 ENGINEERING GRAPHICS II

(Also common with 08A213)

2 0 3 3.5

SECTION OF SOLIDS: Sections of regular solids, types of sections, BIS conventions, selection of sectional views. Sectional views of simple engineering components. (8)

DEVELOPMENT OF SURFACES: Development of lateral surfaces of regular solids, truncated solids and simple engineering sheet metal components. (8)

COMPUTER GRAPHICS: Introduction to 3D modeling packages. Drafting practices - modeling of simple engineering components, sections and extraction of 2D drawings. (6)

PERSPECTIVE PROJECTION: Principles of perspective projection, methods, projection of Solids. (6)

Total 28

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Publishers, 2007.
2. VTU, "A Primer on Computer Aided Engineering Drawing" Belgaum, 2006.

REFERENCES:

1. Kumar M S, "Engineering Graphics", Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, New Delhi, 2003.
3. PSG CAD/CAM Centre Laboratory Manual, Auto CAD Level I and II, 1997.
4. Luzadder W J, "Fundamentals of Engineering Drawing", Prentice Hall Book Co., New York, 1998.

SEMESTER 3

08O201 LINEAR ALGEBRA AND FOURIER SERIES

3 2 0 4

LINEAR ALGEBRA: Euclidean n-space, General vector spaces, Subspaces, Linear independence, Basis and dimension, Row and column spaces, Rank, Finding bases, Inner product spaces, Length and Angle in inner product spaces, Orthonormal bases, Gram Schmidt process, Change of basis. (12)

LINEAR TRANSFORMATIONS: Introduction, Properties-Kernal and range, Linear Transformation from R^n to R^m , Matrices of linear transformations. (7)

EIGEN VALUES AND EIGEN VECTORS: Eigen values and Eigen vectors, Diagonalization, Orthogonal Diagonalization, Symmetric Matrices. Quadratic Forms and its Applications. (7)

FOURIER SERIES: Dirchlet's conditions, Statement of Fourier theorem, Fourier coefficients, Change of scale, Half range series. (6)

BOUNDARY VALUE PROBLEMS: Separable partial differential equations-Classical equations and Boundary value problems, One dimensional wave equations, One dimensional heat equations, two dimensional heat equations - Solution by Fourier series. (10)

Total 42

TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra" John Wiley and Sons, 2005.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 2004.

REFERENCES:

1. Dennis G Zill and Michael R Cullen, "Advanced Engineering Mathematics", Jones and Barlett Publisher, 2005.
2. David C Lay, "Linear Algebra and its Applications", Addison-Wesley, 2004.
3. Ray Wylie C and Louis CBarrett, "Advanced Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd, 2003.

08M303 ELECTRICAL AND ELECTRONICS ENGINEERING

4 0 0 4

INTRODUCTION: Ohms law - Kirchoff's laws – solving simple, DC circuits – Single Phase AC circuits - power, power factor, Introduction to three phase system, Comparison of single phase and Three phase. (5)

ELECTRIC DRIVES: DC drives, DC motors, principle of operation, torque equation, power developed, speed-torque characteristics of series, shunt and compound motors, speed control-armature control, field control. (5)

AC DRIVES: AC machines, Three phase Induction motors, principle of operation, torque equation, speed-torque characteristics of Induction motors, cage and wound rotor types, single phase Induction motors-principle of operation, method of starting, types of single phase motors. (5)

INDUSTRIAL APPLICATIONS: Factors to be considered for selection of motors, determination of power rating of drive motors, selection of motors for cranes, machine tool applications, centrifugal pumps. (4)

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. (6)

ELECTRONIC CIRCUITS: (Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC- DMA Introduction to PLC, coupled amplifier, frequency response. (5)

LINEAR INTERGATED CIRCUITS: Operational amplifiers, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector. (6)

DIGITAL ELECTRONICS: Number systems-binary, octal, hexadecimal, logic gates – AND,OR, NOT, NAND,NOR, XOR, XNOR, Half adder, full adder, subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers. (6)

MICROPROCESSORS: Architecture of Intel 8085, addressing modes, instruction set, machine cycles, timing diagrams, memory diagrams, Memory Mapped I/O Mapped I/O – Stack and Subroutines, interrupts, DMA, introduction to programmable peripherals. (14)

Total 56

TEXT BOOKS :

1. Murugesh Kumar K., "Basic Electrical Science and Technology", Vikas Publishing House Pvt Ltd., 2002.
2. Muthusubramanian R, Salivahanan S and Muraleedharan K.A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill Publishers., Thirteenth reprint, 2006.
3. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Penram International Publishing (India) Pvt Ltd., Fifth Edition, February 2002.

REFERENCES:

1. Pillai S K,"A first course on Electrical Drives", Wiley Eastern Ltd, Bombay 1989.
2. Allen Mottershad,"Electronic Devices and Circuits", PHI, 1996.
3. Boylested," Eletronic devies and Intergrated circuts", PHI, 1997.

08M304 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. Introduction to 4-bar spatial mechanisms. (4)

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. (6)

SYNTHESIS OF LINKAGES: Number and dimensional synthesis – two position synthesis of slider crank and four bar- mechanisms. (2)

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

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, derivatives of follower motion, pressure angle and undercutting, equivalent four-bar mechanism, jump speed analysis. (8)

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. (9)

GYROSCOPIC COUPLE: Gyroscopic couple and its effect in ship, car, motorcycle, aircraft and space vehicles, gyroscopic stabilization. (8)

Total 42

TEXT BOOKS:

1. Shigley J E and Uicker J J, "Theory of Machines and Mechanisms", McGraw -Hill Inc., New Delhi, 1996.
2. Ballaney P L, "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2005.

REFERENCES:

1. Beven T, "Theory of Machines", Third Edition, 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. Rattan S S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 2005.
4. Rao J S and Dukkipati, "Mechanism and Machine Theory", Wiley- Eastern Ltd., New Delhi, 1992.
5. John Hannah and Stephens R C, "Mechanisms of Machines", Viva Low Price Student Edition, New Delhi, 1999.
6. Waldron K J and Kinzel G L, "Kinematics, Dynamics And Design Of Machinery - Ed 2 (Cd - 5650)", John-Wiley and Sons Inc., Second Edition, 2004.
7. Sadhu Singh, "Theory of Machines", Pearson Education, Second Edition, 2006.
8. Erdman AG and Sandor G N, "Mechanism Design, Analysis and Synthesis", Vol.I, PHI Inc., 1997.

08M305 STRENGTH 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)

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. (7)

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. (5)

FLEXURE IN BEAMS: Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to flexure. (5)

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)

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)

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)

Total 42

TEXT BOOK:

1. Punmia B C and Jain A K, "Strength of Materials and Theory of Structures" - Vol.1, Laxmi Publications, New Delhi, 1992.

REFERENCES:

1. Popov E P, "Mechanics of Materials", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1976.
2. Hearn E J, "Mechanics of Materials", Vol. I, Pergamon Press, 1977.
3. Bedi D S, "Strength of Materials", S Chand and Co. Ltd., New Delhi, 1984.
4. Ramamrutham S and Narayan R, "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 1997.
5. Singh D K, "Strength Of Materials", ANE Books, 2007.
6. Jindal U C, "Textbook on Strength of Materials", Asian Books Pvt. Ltd., 2007.
7. Don H Morris, William F Riley and Leroy D Sturges, "Mechanics of Materials", John Wiley and Sons Inc., Fifth Edition, 2001.
8. Lord Chilver and John Case, "Strength of Materials and Structures", Arnold, Fourth Edition, 1999.

08M310 MACHINE DRAWING

(Also common with 08A310)

2 0 3 3.5

INTRODUCTION: Introduction to machine drawing. Importance of sectional views. Computer-aided drafting. (1)

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)

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. (2)

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. (8)

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. (8)

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

Total 28

TEXT BOOKS:

1. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003.
2. CAD/CAM Manual, PSG College of Technology, Coimbatore, 2002.

REFERENCES:

1. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.
2. BIS, SP:46-2003 – "Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.
3. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. DPV Printers, Coimbatore, 1993.
4. ASME Y 14.5M-1994, "Dimensioning and Tolerancing", ASME, New York, 1995.

08M311 STRENGTH OF MATERIALS LABORATORY

0 0 2 1

1. Tension test on metals-stress strain characteristics, ductility, resilience, toughness.
2. Cupping test on metal sheets-load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests.
4. Impact test on metals-Charpy, Izod impact tests.
5. Shear test on metals-direct shear strength, single shear, double shear.
6. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy.
7. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
8. Tests on wood-tension, compression and bending-load deformation characteristics, Young's modulus, modulus of rupture.
9. Fatigue test
10. Metal forming – tension test – finding out n and K .

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering

08M210 ENGINEERING PRACTICES

0 0 2 1

1. Welding - Metal arc welding tools and equipment, exercises.
2. Fitting - Tools, operations, exercises, types of joints.
3. Foundry- Tools, preparation of moulding sand, patterns, cores, foundry exercises.
4. Carpentry- Tools, carpentry process, carpentry exercises, types of joints.
5. Power Tools- Demonstration of tools and operations.
6. Machine Tools I - Demonstration of drilling machine.
7. Machine Tools II - Demonstration of Lathe.
8. Machine Tools III - Demonstration of CNC Lathe and Machining Center.
9. Automobile Engineering - Study of Automobile and Power Transmission.
10. Wood working - Demonstration of wood working machinery and furniture manufacturing.

Total 15

08M312 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

0 0 2 1

1. Verification of Ohm's law and Kirchhoff's laws.
2. Load test on DC series motor.
3. Load test on three-phase induction motor.
4. Study of half wave and full wave rectifiers.
5. RC coupled transistor amplifier.
6. Applications of operational amplifier.
7. Study of logic gates and implementation of Boolean functions.
8. Implementation of binary adder/ subtractor.
9. Study of programming of 8085 microprocessor
10. Interfacing a stepper motor with 8085 microprocessor

REFERENCE:

1. Laboratory Manual prepared by Department of Electrical and Electronics Engineering.

SEMESTER 4

08M306 INDUSTRIAL METALLURGY

3 0 0 3

CRYSTAL STRUCTURE: BCC, FCC and HCP structure- unit cell –crystallographic planes and directions, miller indices-crystal imperfections, point, line, planar and volume defects –Grain size, ASTM grain size number (4)

MECHANICAL PROPERTIES AND TESTING: Mechanisms of plastic deformation, slip and twinning- types of fracture – testing of materials under tension, compression and shear loads-hardness tests (Brinell, Vickers and Rockwell). Impact test Izod and charpy, S-N curves, fatigue and creep test. High cycle fatigue, Low cycle fatigue, Axial fatigue, Rolling contact fatigue, Bending fatigue and Torsional fatigue. (4)

NON DESTRUCTIVE TESTING: Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections, Eddy current testing. (4)

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS: Constitution of alloys –solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron- Iron carbide equilibrium diagram-classification of steel and cast iron microstructure, properties and applications. (8)

HEAT TREATMENT: Definition – full annealing, stress relief, recrystallisation and spheroidizing – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T.diagram CCR- hardenability, Jominy end quench test – Austempering, martempering- case hardening, carburizing, nitriding, cyaniding, carbonitriding- Flame and Induction hardening. (6)

FERROUS MATERIAL: Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) – stainless and tool steels –HSLA- maraging steels – Gray, White malleable, spheroidal – Graphite – alloy castirons. (4)

NON FERROUS MATERIALS: Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin. Important alloys –their composition properties and applications. (4)

NON METALLIC MATERIALS: Introduction to polymers, Composites and Ceramics. (4)

SELECTION OF MATERIALS: Factors to be considered for selection of materials with specific examples. Cost data of metals and alloys. (4)

Total 42

TEXT BOOK:

1. Kenneth G.Budinski and Michael K. Buinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002

REFERENCES:

1. William D Callister, "Material Science and Engineering", John Wiley and Sons, 1997.
2. Raghavan V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 1999.
3. Sydney H Avner, "Introduction to Physical Metallurgy" Mc Graw Hill Book Company, 1994.

08M403 FLUID MACHINERY AND GAS DYNAMICS##

3 1 0 3.5

INTRODUCTION: Energy transfer between fluid and a rotor. Euler's energy transfer equation. Components of energy transfer (4)

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

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)

PUMPS: Radial flow, axial flow and mixed flow pumps - ideal and actual slip, performance calculation and determination of main dimensions. Cavitation in pumps, net positive suction head (NPSH), effect of speed. Fluid coupling and torque converter. (5)

COMPRESSORS: Radial flow and axial flow type. Aerofoil analysis. Surge and stall. (4)

STEAM TURBINES: Types-single stage impulse and reaction type, 50% reaction. Flow through nozzles. Performance of single stage machine. Compounding of turbines. (5)

GAS TURBINE: 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. (5)

GAS DYNAMICS: Mach number.Basics of Isentropic, Fanno and Rayleigh flows. (4)

JET PROPULSION: Turbojet-thrust, thrust power, propulsive efficiency, thermal efficiency, combustion chambers and afterburners. (4)

Total 42

TEXT BOOKS:

1. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion" Vol. III, Wiley Eastern Private Ltd, New Delhi, 1994.
2. Rajput R K, "Thermal Engineering", Laxmi Publications, New Delhi, 2003.
3. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill, Delhi, 2004
4. Ronald L Panton, "Incompressible Flow", Wiley India, 2005.

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 Ltd., New Delhi, 1983.
3. Shepherd 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.

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

08M404 DYNAMICS OF MACHINERY

3 1 0 3.5

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

FLYWHEEL: Turning moment diagram-fluctuation of energy and speed, weight of flywheel required. (7)

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. (8)

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)

VIBRATION MEASUREMENTS AND CONTROL: Selection of measuring instruments – accelerometer – dynamic properties and selection of structural materials for vibration control. (4)

PROPERTIES OF VIBRATING SYSTEMS: Flexibility and stiffness matrices, eigen values and vectors, Maxwell's reciprocal theorem, introduction to multi-degree-of-freedom systems. (2)

FORCED VIBRATION: Response to periodic forcing-forcing by unbalance, support motion, force and amplitude transmissibility, force transmissibility, vibration isolation. (4)

TORSIONAL VIBRATION: Torsional vibration of two and three rotor systems, geared systems, critical speed, signature analysis, two degrees of freedom system. (6)

Total 42

TEXT BOOKS:

1. Shigley J E and Uicker J J, "Theory of Machines and Mechanisms", McGraw Hill, New Delhi, 1996.
2. Ballaney P L, "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2005.

REFERENCES:

1. Bevan T, "Theory of Machines", Third Edition, 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. Rattan S S, "Theory of Machines", Tata Mc Graw Hill, New Delhi, 2005.
4. Rao J S and Dukkipati R V, "Mechanism and Machine Theory", New Age International Limited, New Delhi, 1992.
5. John Hannah and Stephen R C, "Mechanics of Machines", Viva low priced student edition, New Delhi, 1999.
6. Rao SS, "Mechanical Vibrations", Addison Wesley Longman, New Delhi, 1995.
7. Derek Norfield, "Practical Balancing of Rotating Machinery", Elsevier International Projects Ltd, 2006.
8. Nicholas P Cherebinoff, "Noise Control in Industry: A Practical Guide", Noyes Publications, William Andres Publishing, 2003.
9. Kameswara Rao N S V, "Mechanical Vibrations of Elastic Systems", Asian Books Pvt. Ltd., 2006.
10. Graham Kelly S, "Fundamentals of Mechanical Vibrations", Mcgraw Hill, Inc, 2000.
11. Rao V Dukkipati and Srinivas J "Textbook of Mechanical Vibrations", Prentice Hall of India, 2005.
12. Erdman A G and Sandor G N, "Mechanism Design, Analysis and Synthesis", Vol.I, PHI Inc., 1997.

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

08M502 INSTRUMENTATION AND CONTROL SYSTEMS

4 0 0 4

TRANSDUCER VARIABLES AND MEASUREMENT SIGNALS : 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 – frequency response – displacement transducers – potentiometer, strain gauge – orientation of strain gauge, LVDT – variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smart sensors, integrated sensors, radio telemetry, torque measurements, precision systems like video discs and drives, laser printer etc., (8)

VIBRATION AND TEMPERATURE: Elementary accelerometer and vibrometer – seismic instrument for acceleration – velocity measurement, piezo electric accelerometer, temperature measurement-liquid in glass thermometer, pressure thermometer, resistance temperature detector, thermocouples and thermopiles, thermistor, total radiation pyrometer, optical pyrometer – temperature measuring problem in flowing fluid. (8)

PRESSURE AND FLOW MEASUREMENT: Manometer, elastic transducer, elastic diaphragm transducer – pressure cell, bulk modulus pressure gauge – McLeod gauge – thermal conductivity gauge, calibration of pressure gauge, flow measurement – turbine type meter, hotwire anemometer, magnetic flow meter; liquid level sensors, light sensors, selection of sensors. (8)

CONTROL SYSTEM PRINCIPLE: Basic elements of control systems – open loop and closed loop control – elements of closed loop control system – introduction to sampled data, digital control and multivariable control systems. Elements of lead and lag compensation, elements of proportional, integral - derivative (PID) control. (8)

MODELLING OF SYSTEMS: Mathematical Model for mechanical and electrical system - Transfer function – transfer function of hydraulic and pneumatic elements – flapper valve. Transfer function of D C Generator, DC servomotor and AC servomotors, tacho generators, gear trains, potentiometers, synchros – Transfer function of closed loop systems: determination of transfer function for position control, speed control system, temperature control system – block diagram reduction and signal flow graph. (8)

SYSTEM ANALYSIS : Typical test signals – time domain specifications – characteristic equation, time response of first order and second order systems for step input – stability and roots of characteristic equations – roots of characteristic equations – Routh Hurwitz stability concepts. (8)

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA): Overview, architecture, tools alarm, tag logging, history, report generation. Communication protocols of SCADA, interfacing SCADA with field devices. Distributed Control Systems (DCS), architecture, communication facilities, operator and engineering interfaces. (8)

Total 56

TEXT BOOKS:

1. Beckwith T G and Buck N L, "Mechanical Measurements", Addison Wesley Publishing Company Limited, 1995.
2. Gopal M, "Control Systems – Principles and Design", Tata McGraw Hill Co. Ltd., New Delhi, 2002.
3. Michael P Lukas, "Distributed Control Systems", Van Nostrand Reinhold Company, 1995.

REFERENCES:

1. Jain R K, "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
2. Rangan, Mani and Sharma, "Instrumentation", Tata McGraw Hill Publishers, New Delhi, 2004.
3. Nagarath I J and Gopal M, "Control Systems Engineering", New Age International Publishers, 2007.
4. CIMPLICITY SCADA packages Manual, Fanuc India Ltd., 2004.
5. Alan S Morris, "Measurement and Instrumentation Principles", Butterworth, 2006.
7. Dominique Placko, "Fundamentals of Instrumentation and Measurement", ISTE, 2007.
8. Regtien PPL, "Measurement Science for Engineers", Kogan Page, 2005.

08M411 EXPERIMENTAL FLUID MECHANICS 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 variable speed 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.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M412 DYNAMICS LABORATORY

0 0 2 1

1. Static and dynamic balancing using rotating unbalance test rig.
2. Preparation of cam displacement curve and determination of jump speed of a cam.
3. Determination of natural frequencies of transverse and torsional vibrations.
4. Shaft alignment testing.
5. Determination of pressure distribution in journal bearing.
6. Determination of critical speed of shafts.
7. Measurement of friction and wear.
8. Determination of moment of inertia of connecting rod and validation using software
9. Measurement of radius of gyration of compound pendulum and validation using software.
10. Free fall drop impact testing for hand held product.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M413 METALLURGY LABORATORY

0 0 2 1

1. a. Study of Metallurgical Microscope
b. Specimen preparation for metallographic studies
2. Study of unetched Grey cast iron, SG iron and Malleable cast iron.
3. Study of etched Grey cast iron, SG iron and Malleable cast iron
4. Study of low carbon steel and medium carbon steel
5. Study of high carbon steel and white cast iron.
6. Study of hardened steel and case carburized steel
7. Study of tool steel and stainless steel.
8. Study of Al and Cu alloys
9. Inclusion rating
10. Case studies of Metallurgical failure analysis.

REFERENCE:

1. Laboratory Manual prepared by Department of Metallurgical Engineering

08M420 INDUSTRIAL VISIT CUM LECTURE

0 0 2 1

- ❖ Visits to local industries will be arranged by the department to study the industrial practices.
- ❖ Lectures by experts will be arranged to gain exposure to the trends in design, manufacturing and quality control in industries.

SEMESTER 5

08M401 MANUFACTURING TECHNOLOGY I

4 0 0 4

FOUNDRY EQUIPMENTS AND MATERIALS: Patterns. Moulds-types of moulds, moulding sand characteristics and testing procedures. Core making, melting furnaces. (9)

PRODUCTION OF CASTINGS: Processes-shell moulding, investment castings, centrifugal castings, die casting. Gating and risering. Fettling and cleaning of casting. Inspection and testing of castings. Casting defects and remedies. (9)

GAS WELDING: Oxy-acetylene welding, types of flames, welding torches, welding techniques. (5)

ARC WELDING AND RESISTANCE WELDING: Arc welding-carbon arc, shielded metal arc, submerged arc, TIG and MIG welding. Welding electrodes-function and characteristics of electrode coating. Resistance welding-spot, seam, projection and butt welding, heat flow in welded components. Other welding process, Laser beam welding, Electron beam welding. Friction welding, Friction stir welding and Ultra sonic welding. (10)

METAL FORMING PROCESSES: Cold and hot working, rolling, drawing, extrusion and forging, sheet metal cutting, bending. Drawing applications, defects. Types of presses. (9)

SPECIAL FORMING METHODS: Explosive forming, electro magnetic forming, electro hydraulic forming, powder metallurgy process, composite mouldings. (9)

INTRODUCTION TO SOFTWARE FOR MANUFACTURING APPLICATIONS: Metal forming and flow analysis software (for metallic /plastic components). (5)

Total 56

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Casting", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2005.
2. Rao P N, "Manufacturing Technology", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1998.
3. Khanna O P, "Welding Technology", Dhanpat Rai and Sons, New Delhi, 1994.
4. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Company, inc., Third Edition, 1995.

REFERENCES:

1. SME, "Tool and Manufacturing Engineers Handbook", Vol.,2, McGraw Hill Book Co., New York, 1984.
2. Parmar R S, "Welding Processes and Technology", Khanna Publishers, Delhi, 1992.
3. Krishna K Chawla, "Composite Materials-Science and Engineering", Springer Verlag, New York, 1987.
4. William K Dalton, Gregg Bruce R, "Modern Materials and Manufacturing Processes", Pearson Education, 2007.
5. Elanchezhian C, Vijaya Ramnath B, "Manufacturing Technology – 1", Laxmi Publication, 2005.
6. Peter Beeley, "Foundry Technology", Butterworth, Second Edition, 2005.
7. Baldev Raj and Shankar V, "Welding Technology For Engineers", Narosa Book Distributors Pvt. Ltd., 2006.

08O301 TRANSFORMS AND COMPLEX ANALYSIS

3 2 0 4

TRANSFORM METHODS: Concept of Transformation – examples for Transformation. (2)

LAPLACE TRANSFORM: Definition – Transforms of standard functions – Transform of unit step function – Dirac -Delta function- Transforms of derivatives and integrals – Transforms of Periodic functions – Inverse Laplace transform – Convolution theorem – method of solving ordinary linear differential equations with constant coefficient by Laplace transform technique. Some applications to engineering problems. (10)

FOURIER TRANSFORM: Fourier integrals – Fourier transform – Finite and infinite Fourier sine and Cosine transform – Transforms of standard functions – properties, Convolution theorem(Statement only) – Discrete Fourier and Fast Fourier Transforms – Discrete convolution – periodic sequence and circular convolution – Discrete Fourier transform – decimation- in-time algorithm – computation of inverse DFT. (10)

Z-TRANSFORM: Z- transform of standard functions, inverse Z-transform (Partial fraction expansions) – properties of Z – transform – Solution of difference equations. (8)

COMPLEX VARIABLES : Analytic functions – Cauchy Reimann equations in cartesian and polar – coordinates – statement of sufficient conditions – properties of analytic functions – finding analytic function whose real / imaginary part is given – conformal mapping , Bilinear map – study of mappings $w = \exp(z)$, $\sin z$, $\cos z$, $\sinh z$, $\cosh z$, $1/z$, $z+k/z$ – complex integration – Cauchy's fundamental theorem and formula- Taylor's series – Laurent's series (Statement only) – Singularities – Residue theorem – Cauchy's lemma and Jordan's Lemma (Statement only) – evaluation of real integrals using contour integration along semi circle and unit circle. (12)

Total 42

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 2001.

2. Robert A. Gabel, Richard A. Roberts, "Signals and Linear systems", John Wiley and Sons, 1995.
3. Ray Wylie C, Louis C Barret, "Advanced Engineering Mathematics", McGraw-Hill, 2001.
4. Riley K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering", Cambridge University, 2004.

08O302 ECONOMICS FOR BUSINESS DECISIONS

3 0 0 3

INTRODUCTION TO ECONOMICS: Definitions – Scope and Significance of Economics in Decision Making – Various Economic Tools and Techniques. (2)

CALCULATING PERCENT CHANGE AND COMPOUNDED GROWTH RATES: Some Mathematical Concepts and Analytical Tools. (3)

ECONOMIC THEORY OF CONSUMER DEMAND: Law of Demand – Determinants of Demand – Exceptions to Law of Demand Elasticity of Demand – Various types of Elasticity and measurements of Price Elasticity and Demand Forecasting Methods and its Applications. Law of Supply – Elasticity of Supply – Determinants of Elasticity of Supply. (6)

ECONOMIC THEORY OF THE FIRM (Cont'd): (Input Markets) – Production Function – Factors influencing Production – Cobb-Douglas Production Function – Economies of Scale – Returns to Scale – Cost Analysis - Various Cost Concepts - Cost Output Relationship and Short Run and Long Run. (6)

MARKET STRUCTURE AND COMPETITION: Various Forms of Market Structure – Perfect Competition - Imperfect Competition – Monopoly – Monopolistic – Oligopoly – Pricing Strategies and Price Discrimination in various Market Structures. (4)

MARKET FAILURES AND GOVERNMENT INTERVENTION IN THE MARKET ECONOMY: Basic Functions of Government – Market Efficiency – Tools of Government Intervention. (4)

INTRODUCTION TO MACROECONOMICS: (Measuring Aggregate Output) Meaning – Objective and Issues of Macroeconomics- National Output Concept – GDP, GNP, NNP, Per Capita Income, Disposable Income, Personal Disposable Income – Various Methods of Measuring National Income - Inflation – Deflation. (5)

AGGREGATE EXPENDITURES AND FISCAL POLICY: (Fiscal Policy) Objectives of Fiscal Policy – Instruments of Fiscal Policy – Taxation. Highlights of Current Fiscal Policy. (6)

MONEY AND BANKING: (Monetary Policy) Functions of Money - Value of Money - Objectives and instruments of Monetary Policy – Highlights of Current Monetary Policy – Banking – Types of Banks - Central Bank and Commercial Banks - Objectives and Functions of Central Bank and Various Types of Commercial Banks and Its Functions. (4)

ECONOMIC GROWTH: Meaning – Benefits and Costs of Growth. (2)

Total 42

TEXT BOOK:

1. Paul A Samuelson and William D Nordhaus, "Economics", Tata McGraw Hill, New Delhi, 2007.

REFERENCES:

1. Karl E Case and Ray C Fair, "Principles of Economics", Prentice Hall, 2008.
2. Misra S K and Puri V K, "Economic Environment of Business", Himalaya Publishing House, New Delhi, 2002.
3. Richard G Lipsey, Colin Harbury Weidenfeld and Nicolson, "Principles of Economics", London, 1990.

08M402 APPLIED THERMODYNAMICS

3 1 0 3.5

BASIC CONCEPTS OF THERMODYNAMICS: System, property, state and equilibrium, process and cycle, work, heat and other forms of energy. Zeroth law and application, first law statement, applications to closed and open systems, general energy equation and applications to thermal equipments. (8)

SECOND LAW OF THERMODYNAMICS: Statements-heat engines and heat pump, reversibility, Carnot cycle and Carnot theorem (4)

ENTROPY: Clausius theorem, Clausius inequality, principle of increase in entropy, T-S relations, availability and irreversibility (4)

PROPERTIES OF PURE SUBSTANCE: Pure substance, phase-change processes, property diagram for phase processes, properties table, Mollier chart. (4)

VAPOUR POWER CYCLE : Rankine and modified Rankine cycle, Reheat cycle, Regenerative cycle, Reheat- Regenerative cycle, Binary vapour cycle (6)

PROPERTIES OF IDEAL GASES AND REAL GASES: Ideal gas equation, evaluation of work and heat, entropy changes, real gases, Van der Waals equation, compressibility - universal compressibility chart and general thermodynamic relations. (6)

PSYCHROMETRY: Properties – atmospheric air, psychrometry Chart. (4)

THERMODYNAMIC CYCLES: Air standard cycles-Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, and Dual Cycle Brayton cycle. (6)

Total 42

TEXT BOOKS:

1. Cenge Y Al and Boles M A "Thermodynamics, An Engineering Approach" Tata McGraw Hill, 2003.
2. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill, Delhi, 2004.

REFERENCES:

1. Holman J P, "Thermodynamics", Tata McGraw Hill, 1998.
2. Sonntag R E, Borgnakke C and Van Wylen G J, "Fundamentals of Engineering Thermodynamics", John Wiley, 2003.
3. Rogers G F C and Mayhew Y R, "Engineering Thermodynamics Work and Heat Transfer", Pearson, 2003.
4. Kothandaraman C P and Domkundwar S, "Engineering Thermodynamics, Part I, Dhanpat Rai and Sons, Delhi, 2004.
5. John P O Connell and Haile J M, "Thermodynamics Fundamentals for Applications", Cambridge.
6. Yunus A Cengel and Michael A Boles, "Thermodynamics and Engineering Approach", TMH.
7. Jones J B and Dugan R E, "Engineering Thermodynamics", Prention Hall India.
8. Eugene Silberstein, "Heat Pumps", Thomson.

08M503 METROLOGY AND QUALITY ASSURANCE

3 0 0 3

BASICS OF MEASUREMENT AND DEVICES: Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe's Principle, Principle of interferometry- flatness testing, optical interferometer, laser interferometer. Holography and speckle metrology. (6)

QUALITY STANDARDS: General cares and rules in measurement, International standardization, SI units and quantities, BIS- NPL – advantages, ISO 9000 quality standards, QS 9000 standards, Environment standards, metrology room measuring standards room. (5)

LINEAR MEASUREMENTS: Material length standards –line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators-mechanical, electrical, optical and pneumatic, optical projector. (5)

GEOMETRICAL MEASUREMENT: Angular measurement – plain vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gauge, Taylor's principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used, specification of surface texture, drawing and symbols, Tomilson surface meter. CMM. (6)

METROLOGY OF MACHINE ELEMENTS: Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment. (6)

MACHINE INSTALLATION AND TESTING: Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list. (5)

STATISTICAL QUALITY CONTROL: Process capability, steps in using control charts, basic principles of lot sampling – sampling inspection, single and double sampling, determination of sample size, OC curves, AOQ, ABC standards. (4)

QUALITY CONTROL CHARTS: Types, manufacturing specifications, p chart, np chart, c chart, u chart, X and R chart – solving problems using the charts. Design of tool for inspection, gauging design of plug, snap gauges, thread gauges. Gauge repeatability and reproducibility studies. (5)

Total 42

TEXT BOOKS:

1. Gupta I C, "A text book of Engineering Metrology", Dhanpat Rai publications, New Delhi, 2003.
2. Jain R K, "Mechanical and Industrial Measurements", Khanna Publishers Co Ltd., New Delhi, 1985.
3. Holmen J P, "Experimental Methods for Engineers", Tata McGraw Hill Publications Co Ltd, 2004.
4. John G Nee, "Fundamentals of Tool Design" Society of Manufacturing Engineers, Fourth Edition, 1998.
5. Dominique Placko, "Metrology in Industry: The Key for Quality", ISTE, 2007.

REFERENCES:

1. Narayana K, "Engineering Metrology", Scitech Publication, 2006.
2. Kaniska Bedi, "Quality Management", Oxford University Press, Chennai, 2007.

08M510 SENSOR INTERFACE LABORATORY

0 0 2 1

1. Interfacing of Thermo couple, RTD and thermistor with PC
2. Interfacing of LVDT with PC
3. Interfacing of PFCV and Flow Sensor with PC
4. Interfacing of Piezo – electric accelerometer with PC and Microphone and performing order analysis
5. Inspection using Vision System
6. Measurement of force using proving ring
7. Measurement of strain using Wheatstone bridge and interface with PC
8. Control system exercise using PC- stepper motor level
9. Programming motion control system for robot using PC and acoustic sensors
10. Product RFD identification using system identification of a single degree of freedom setup,

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M511 METROLOGY LABORATORY

0 0 2 1

1. (i) Gear roll testing (ii) gear concentricity testing
2. (i) Measurement of gear profile using optical profile projector (ii) measurement of thread using thread comparator
3. (i) Angular measurement using sine bar (ii) measurement using laser micrometer
4. (i) Surface finish measurement of machined components (ii) measurement using height master, height gauge
5. Tool geometry measurement using tool makers microscope
6. Gauge repeatability and reproducibility R & R study exercise.
7. A study of co-ordinate measuring machine, pneumatic comparator, laser interferometer
8. Measurement of internal, external tapers, standard sphere, pin.
9. Bore measurement using bore dial guage, go-no go gauges.
10. Screw thread metrology - 3- wire method.
11. Acceptance test for lathe as per standards
12. Auto collimator for form measurement

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M512 MANUFACTURING PROCESS LABORATORY II

0 0 2 1

1. Internal and external dovetail machining using shaper
2. Experiment in spark erosion process
3. Experiment in surface grinding and cylindrical grinding processes
4. Experiment in tool grinding – single point and multi point tools
5. Experiment in spur gear milling
6. Experiment in keyway slotting
7. Experiment in spur gear shaping
8. Experiment in spline milling and pocket milling
9. Experiment in milling maximum square and hexagon on each end of M S Rod.
10. Measurement of cutting forces using tool dynamometer.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER 6

08M501 MANUFACTURING TECHNOLOGY II

4 0 0 4

THEORY OF METAL CUTTING: Introduction, mechanics of metal cutting, orthogonal and oblique cutting, merchants equation, chip formation, heat generation, cutting fluids, cutting tool life - recent developments and applications (Dry machining and high speed machining). (8)

TOOLS AND MACHINE TOOLS: Cutting tool materials, cutting tool nomenclature, introduction to machine tools, lathe, shaper, planing, milling, drilling and boring machines, working principle, operations, work holding devices. (10)

MANUFACTURE OF COMPONENTS: Production of axi-symmetrical components- shafts, hubs, pins. Production of prismatic components- housings, lathe beds, gearboxes, machine columns. Hole production in components using drilling and boring. (6)

SURFACE FINISHING PROCESSES: Grinding machines, grinding wheel specification, honing, lapping, burnishing, super finishing surface integrity concepts. (6)

GEAR MANUFACTURING: Gear manufacturing processes-gear welding, gear hobbing, shaping machines, manufacture of spur, helical, bevel, worm and worm wheel. Gear finishing. (7)

ECONOMICS OF MACHINING: Calculation of machining time for turning, drilling, shaping, milling and grinding, cost estimation. General principles of economics of machining. Economic tool life, optimal cutting speed for maximum production, estimation of machine hour rate and machining cost computations. (7)

NON - TRADITIONAL MACHINING: Need for non-traditional machining, ultrasonic machining, abrasive jet machining, laser beam machining, equipments, applications, advantages and limitations. Micromachining and its applications. (6)

THERMAL MACHINING PROCESS: Electron beam machining, electric discharge machining, electric discharge wire cutting, electro chemical machining, electro chemical grinding, equipments, applications, advantages and limitations. (6)

Total 56

TEXT BOOKS:

1. Bhattacharya A, "New Technology", IE Publishing, New Delhi, 1984.
2. Milton C Shaw, "Metal Cutting Principles", Clarendon Press, Oxford, 1999.
3. Singh D K "Manufacturing Technology", Pearson Education, 2004.
4. Kalpakjian, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company Inc., Third Edition, 1995.

REFERENCES:

1. HMT, "Production Technology" Tata McGraw-Hill Co., New Delhi, 1998.
2. James Brown, "Advanced Machining Technology Handbook", McGraw Hill Book Company, New York, 1998.
3. ASM, "Handbook on Metals", Vol. 3, McGraw- Hill Book Company, New York, 1994.
4. Pandey P C, "Modern Machining Processes", Tata McGraw Hill Publications Co. Ltd., New Delhi, 1993.
5. Edward M Trent, Paul K Wright, "Metal Cutting", Butterworth, Fourth Edition, 2006.
6. Anne Marie Habraken, "Material Forming Processes", ISTE, 2007.
7. Germaine Nefussi, Mircea Predeleanu and Arnaud Poitou, "Prediction of Defects in Material Processing", Kogan Page, 2004.

08M504 DESIGN OF MACHINE ELEMENTS I

3 1 0 3.5

TORQUE MEASUREMENTS: Precision systems like video discs and drives, laser printer etc. (2)

STRESS ANALYSIS: Types of stresses, stress-strain diagram in tension, mechanical properties of materials, static stress equation in axial, bending and torsional loading, criteria for failure, factor of safety. (3)

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

VARIABLE LOADS: Mechanism of fatigue failure (in brief)-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)

AN OVERVIEW OF FRACTURE MECHANICS DESIGN : Three modes of crack opening, stress intensity factor, significance of fracture mechanics in design. (2)

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 square keys-use of standards, rigid couplings, flexible flange couplings - selection. (5)

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. (5)

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. (5)

BOLTED JOINTS: Elementary treatment only (not for examination purposes) (2)

SLIDING CONTACT BEARINGS: Theory of lubrication, hydrodynamic bearings, Sommerfield number, design of hydrodynamic bearings. (5)

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. (4)

Total 42

Note: 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).

TEXT BOOKS:

1. Robert L Mott, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London, 1992.
2. Robert L Nortan, "Machine Design-An Integrated Approach", Pearson Publishers, New Delhi, 2003.

REFERENCES:

1. Bandari V B, "Design of Machine Elements ", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.
2. Shigley and Mischke, "Mechanical Engineering Design", McGraw Hill Publishers Co. Ltd., New Delhi, 2000.
3. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. DPV Printers, Coimbatore, 2000.
4. John M Barson and Stanely T Rolfe, "Fracture and Fatigue Control in Structures", Prentice-Hall Inc., New Jersey, 1987.
5. Jacobson B O, Bernard J Hamrock and Steven R Schmid, "Fundamentals of Machine Elements ", McGraw Hill, Inc., Second Edition, 2006.

08M505 THERMAL ENGINEERING

3 1 0 3.5

I C ENGINES: Classification. Principle and working of four stroke and two stroke petrol and diesel engines with p-v and valve timing diagrams. Comparison of petrol and diesel engines - two stroke and four stroke engines. (5)

FUEL SUPPLY AND IGNITION SYSTEM: Working principles of simple and modern carburetors with modifications for variable speed, load operation. Diesel fuel pumps and injector-working principle-engine lubrication and cooling. Battery and coil, magneto type and electronic systems. Alternate fuels- bio fuels environment friendly fuels. (5)

TESTING AND PERFORMANCE: Testing of IC engines-constant speed and variable speed tests, methods of estimating indicated power, brake power, volumetric efficiency. Heat balance test. (6)

COMBUSTION ENGINEERING: Combustion process-knocking, detonation, Cetane and Octane numbers. Heating value-liquids and gaseous fuels, combustion. Wankel engine-rotor and stator geometry, advantages and limitations. Environmental pollution. (4)

REFRIGERATION: Methods of refrigeration-air refrigeration, Bell Coleman cycle, vapour compression refrigeration cycle, use of T-s diagrams, under-cooling and superheating. Performance calculations of air and vapour compression refrigeration systems. Study of absorption refrigeration system and comparison of various refrigeration cycles. Refrigerants - types and properties. (5)

AIR-CONDITIONING: Requirements for comfort and industrial air-conditioning, air washer, by-pass factor, summer and winter air conditioning systems. (5)

SINGLE STAGE RECIPROCATING COMPRESSOR: Working principle-effect of clearance on volumetric efficiency, equations for shaft work and efficiencies. (5)

MULTISTAGE RECIPROCATING AND ROTARY COMPRESSORS: Working principle, inter-cooler, optimum intermediate pressure in a two stage compressor and performance of multi-stage compressor. Rotary positive displacement compressor- types, performance calculations. Air motor- performance. (5)

AN OVERVIEW OF POWER PLANTS

(2)

Total 42

TEXT BOOKS:

1. Kothandaraman C P and Domkundwar S, "Thermodynamics and Thermal Engineering", DhanpatRai and Sons, New Delhi, 2004.
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.

REFERENCES:

1. Ganesan V, "Internal Combustion Engine", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 1995.
2. Colin R Ferguson, "Internal Combustion Engines", John Wiley and Sons, New York, 1986.
3. Edward F Obert, "Internal Combustion Engines", Interscience Publishers, 1971.

4. Mathur M L, Sharma R P, "Internal Combustion Engines", Dhanpat Rai and Sons, Delhi, 1997.

08M513 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

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M410 MANUFACTURING PROCESS LABORATORY I

0 0 2 1

1. Facing and step turning operation
2. Drilling and taper turning
3. Grooving, chamfering and knurling
4. Thread cutting operation – external and internal
5. Field study involving actual measurement of cutting time inturning, drilling and comparing with theoretical calculations
6. Eccentric turning
7. Pin and bush assembly for $H_8 e_8$ clearance fit
8. Smooth contour machining
9. Demonstration of press operations
10. Dismantling and assembly of tailstock

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER 7

08M602 MECHATRONIC SYSTEM DESIGN

4 0 0 4

FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Introduction to HMI systems – text display, touch panels and integrated displays. (5)

TRANSFER LINES AND AUTOMATED ASSEMBLY: General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing. (5)

PNEUMATIC CONTROL: Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments. (6)

PNEUMATIC CONTROL SYSTEM DESIGN: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping. (6)

PROGRAMMABLE LOGIC CONTROLLERS: Basic structure, input/output programming, timers, relays, counters, analogue input/output, interfacing with PC, pneumatic sequencing, control problem using PLC. (7)

PROGRAMMABLE AUTOMATION: Computer Numerical Control-basic theory, advantages of numerical control. Open and closed loop systems, information flow and coding theory. Classification of CNC machine tools. Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems. (7)

CNC PART PROGRAMMING: Manual and computer aided part programming-G and M functions, canned cycles. Generation using CAM software. (8)

ROBOTIC SYSTEMS: Basic structure of a robot-robot end effectors. Classification of robots-accuracy, resolution and repeatability of a robot. Drives and control systems-mechanical components of robots-sensors and vision systems. Transducers and sensors-tactile sensors, proximity sensors and range sensors, vision systems. Robot motion control and robot programming. (6)

DESIGN OF MECHATRONIC SYSTEMS: Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system. (6)

Total 56

TEXT BOOKS:

1. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.
2. Wemer Depper and Kurt Stoll, "Pneumatic Application", Kemprath Reihe, Vogel Buch Verlag Wurzburg, 1987.
3. Bolton W, "Mechatronics", Pearson Education, Second Edition, 1999.
4. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill , New York, USA. 2000.
2. Wemer Depper and Kurt Stoll, "Pneumatic Application", Kemprath Reihe, Vovel Verlag , Wurzburg, 1976.
3. Festo K G, "Pneumatic Tips", Festo, Germany, 1987.
4. Nitaigour Premchand Mahadik, "Mechatronics", Tata Mc Graw-Hill, Publishing Company, Ltd., 2003.
5. Rolf Isermann, "Mechatronic Systems Fundamentals", Springer, 2003.
6. John W Webb and Ronald A Reis, "Programmable Logic Controllers", Prentice Hall, Inc., 1999.
7. Robert H Bishop, "Mechatronics: Introduction", Taylor and Franics, 2006.
8. Peter Smid, "CNC Programming Techniques: An Insider's Guide to Effective Methods and Applications", Industrial Press, 2006.
9. Wisama Khalil and Etienne Dombre, "Robot Mainpulators Modeling, Performance Analysis and Control", ISTE, 2007.
10. Mark W Spong and Seth Hutchinson, "Robot Modeling and Control", Wiley-India Pvt. Ltd., 2006.

08M603 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)

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)

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

CONCEPTS OF BOUNDARY LAYER: Differential and integral equations for hydrodynamics and thermal boundary layer. (3)

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)

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

BOILING AND CONDENSATION: Boiling heat transfer - bubble growth, freezing and melting. Condensation, film condensation and drop wise condensation. (3)

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)

MASS TRANSFER: Rate equations. Mass diffusion in binary mixtures, evaporation in a column, forced convective mass transfer. Heat and mass transfer analogies. (6)

Total 42

TEXT BOOKS:

1. Yunus A Cengel, "Heat Transfer: A Practical Approach", Second Edition, Tata McGraw Hill Inc., New York, 2005.
2. Holman J P, "Heat Transfer", McGraw Hill Inc., New York, 1997.
3. Kothandaraman C P, "Fundamentals of Heat and Mass Transfer", Second Edition, New Age International Publishers, Chennai, 1997.
4. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 2004.
5. Nag P K., "Heat and Mass Transfer", Tata McGraw Hill Publishing Company, New Delhi, 2004.

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.
4. Donald Q Kern, "Process Heat Transfer", TMH.

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

08M604 DESIGN OF MACHINE ELEMENTS II**3 1 0 3.5**

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

SELECTION OF BELTS FOR SPINDLE DRIVE AND FEED DRIVE IN APPLICATION FOR CNC MACHINE TOOLS: Poly Vee Belts, HTD belts, V-belts of 3V, 5V and 8V types. Taper lock bushes and timing belts – SPZ, SPA, SPB, SPC types. (5)

POWER SCREWS: Forms of threads, force analysis, square and trapezoidal threads, collar friction, design of power screws (for screw jack, lathe, etc..) selection of ball screws. (5)

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, equivalent number of teeth, determining dimension of helical gear pair. Nomenclature of straight and bevel gears. (6)

WORM GEARS: Nomenclature, thermal capacity, efficiency, design of a pair of worm gears. (5)

MULTI SPEED GEAR BOX: Ray diagram, gear tooth profile correction, finalisation of the gear train; gear tooth loads and bearing reactions. (5)

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. (5)

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. (5)

Total 42

Note: 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).

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. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s DPV Printers, Coimbatore, 2000.
4. V B Bhandari, "Design of Machine Elements", Tata McGraw Hill Publishing Co .Ltd, New Delhi, 2003.
5. Prabhu T J, "Design of Transmission Elements", Mani offset, Chennai, 2003.
6. Darle W Dudley, "Hand Book of Practical Gear Design", CRC Press, Florida, 2002.
7. Allen S Hall and Alfred R Holowenko, "Schaum's Outlines of Theory and Problems of Machine Design", Tata McGraw-Hill, 2006.

08M703 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. (5)

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. (16)

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

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. (6)

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. (4)

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. (3)

Total 42

TEXT BOOKS:

1. Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Pearson Education 2002, Third Edition.
2. Logan D L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2002.
3. John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New Delhi, 1995.

REFERENCES:

1. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Int. Ed., New Delhi, 2004.
2. Rao S S, "The Finite element Method in Engineering", Pergammon Press, 2005.
3. Reddy J N, "An Introduction to Finite Element Method", McGraw Hill International Student Edition, New Delhi, 1985.
4. Seshu P, "A Text book on Finite Element Analysis", Prentice Hall of India, New Jersey, 2003.
5. Cook R D, Malkus D S and Plesha M E, "Concepts and Applications of Finite Element Analysis", Fourth Edition, John Wiley and Sons, New Delhi, 2003.
6. Zienkiewicz OC, Cheung YK, "Finite Element Method", McGraw Hill Inc., 1970.
7. Kwentin Renalds, "Right Sagotharargal (Tamil)", Palaniappa Brothers, 2000.
8. Nils Erik Wilberg, "Finite Element Method Basics", Overseas Press (India) Pvt. Ltd., 2006.
9. Alexandre Ern and Jean Luc Guermond, "Theory and Practice of Finite Elements", Springer, 2005.
10. Hibbeler R C, "Mechanics of Materials", Pearson Education, Sixth Edition, 2007.
11. Entwistle K M, "Basic Principles of the Finite Element Method", Woodhead Publishing Ltd., 2006.

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

08M710 COMPUTER AIDED ENGINEERING LABORATORY

0 0 2 1

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.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

Note: 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).

08M610 HEAT AND MASS TRANSFER LABORATORY

0 0 2 1

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.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M611 MECHATRONICS LABORATORY

0 0 2 1

1. Design and simulation of multiple actuator systems using Pneumatic elements.
2. Design and simulation of multiple actuator systems with start selection and emergency modules.
3. Design and simulation of multiple actuator circuits using Electro Pneumatic elements.
4. Design and simulation of PLC based multiple actuator systems.
5. Microprocessor based stepper motor control.
6. Programming and machining in CNC Lathe
7. Programming in CNC machining centre
8. CNC code generation using software and simulation in a CNC lathe and CNC milling
9. Experiment using conveyor
10. Creating screens using SCADA, screen navigation and developing applications using graphics library.
11. Configuring HMI and creating screens, tags and developing an application using PLC
12. Study of servo systems.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

08M520 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**

SEMESTER 8

08M601 DESIGN FOR MANUFACTURE AND ASSEMBLY

(Also common with 08A007)

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, design for assembly, DFA index, Poka - Yoke principle; 6σ concept; design creativity. (6)

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. (6)

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)

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)

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)

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 – design considerations for plastic component manufacturing. (4)

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features - functional and manufacturing, component design-machining considerations, redesign for manufacture, examples. (6)

LEAN MANUFACTURING: Need for lean concepts, different types of waste, metrics of manufacturing, an overview of value stream mapping- present state map, future state map, evaluation of benefits – Process FMEA, Design FMEA. (3)

Total 42

TEXT BOOKS:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983.
2. Matousek R, "Engineering Design- A Systematic Approach", Blackie and Son Ltd., London, 1974.

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, 1967.
3. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
4. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, Second Edition, 1987.
5. Poka-Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.
6. Creveling C M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley Longman Inc.,USA, 1997.
7. Pahl G and Beitz W, "Engineering Design-Systematic Approach", Springer Verlag Pub., 1996.
8. Mamboed M Farag, "Material Selection for Engineering Design", Prentice Hall, New Jersey, 1997.
9. Dennis P Hobbs, "Lean Manufacturing Implementation: A Complete Execution Manual for any Size Manufacturing", J Rose Publishing Inc., 2003.

08M605 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 (3)

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. (8)

TRANSPORTATION PROBLEMS: Least cost method, North west corner rule, Vogel's approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model. (5)

ASSIGNMENT MODELS AND SCHEDULING: Difference between transportation problem and assignment problem, Hungarian algorithm, unbalanced assignment problems maximization case in assignment problems, traveling salesman problem. Scheduling - processing n jobs through two machines, processing n jobs through three machines, processing two jobs through 'm' machines, processing n jobs through m machines. (6)

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)

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. (4)

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

GAME THEORY: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game , n person zero sum game. (4)

REPLACEMENT MODELS: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement (3)

Total 42

TEXT BOOKS:

1. Elwood S Buffa, "Modern Production /Operations Management", Wiley Eastern, New Delhi, 1991.
2. Kanti Swarup, Gupta P K and Manmohan, "Operations Research", Sultan Chand and Sons New Delhi, 1995.

REFERENCES:

1. Viswanathan N , Narahari Y , "Performance Modeling of Automated Manufacturing Systems" , Printice Hall Inc ,1992.
2. Srinath L S, "PERT and CPM – Principles and Applications", East West Press, New Delhi, 1982.
3. Dharani Venkatakrisnan 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.

08M704 TOOL DESIGN**3 0 0 3**

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

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)

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)

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)

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)

PRESS TOOLS: 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. Selection of presses and tools. (6)

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 mould flow. (4)

SPECIAL TOOLS: Design of limit gauges. Tool maintenance and planning. (4)

Total 42**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 Ltd., New Delhi, 2004.
3. Bhattacharyya A, "Metal Cutting Theory and Practice", New Central Books Agency (P) Ltd, Calcutta, 2000.
4. Cracknell P C and Dyson R W, "Handbook of Thermoplastics Injection Mould Design", Chapman and Hall, 1993.
5. Mikell P Groover, "Fundamentals of Modern Manufacturing", John Wiley and Sons, Singapore, 2004.

REFERENCES:

1. SME, "Manufacturing Engineers Hand Book", 1998.
2. Kempster, "Introduction to Jig and Tool Design", VIVA Books, New Delhi, 1998.
3. Rodin P, "Design and Production of Metal cutting Tools", MIR Publishers, Moscow, 1968.

08M702 MANUFACTURING SYSTEMS DESIGN##**3 0 0 3**

INTRODUCTION TO MANUFACTURING SYSTEMS AND MODELS: Evolution of industrial engineering, fields and functions of industrial engineering. Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building (8)

DESIGN OF AUTOMATED LINES: Assembly lines-Reliable serial systems, approaches to line balancing – COMSOAL and RPW, Transfer lines and general serial systems – paced lines without buffers. Flexible manufacturing systems- system components, Introduction to planning and control. (10)

LAYOUT DESIGN : Group technology- introduction ,part classification and coding, assigning machines to groups-Rank order clustering algorithm, Facility layout – Sequential layout planning. (6)

SUPPORTING COMPONENTS: Machine setup and operation sequencing, Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking. (5)

SIMULATION IN SYSTEM DESIGN: Empirical simulation models-Event models, process models, simulation system, example manufacturing system (5)

SYNCHRONIZATION MANUFACTURING: Synchronization Vs Optimization, defining the structure, identifying the constraint, Exploitation, Buffer Management. (3)

PRODUCTION PLANNING AND CONTROL: Introduction, objectives, components of PPC, forecasting, product planning, loading and scheduling, dispatching, production control, material handling principles, case studies. (5)

Total 42

TEXT BOOKS:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.
2. Mengchu Zhou, "Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach", World scientific Publishing Company Pvt Ltd., 2000.
3. Jean Marie Proth and Xiaolan Xie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley and Sons, New York, 1996.

REFERENCES:

1. P Brandimarte, A Villa, "Modeling Manufacturing Systems", Springer Verlag, Berlin, 1999.
2. Richard Crowson, "Factory Operations: Planning and Instructional Methods - Ed2", CRC Press, Second Edition, 2006.
3. Phillip F Ostwald, Jairo Munoz, "Manufacturing Processes and Systems", John Wiley and Sons Inc., Ninth Edition, 2002.

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

08M621 COMPREHENSIVE VIVA VOCE

0 0 2 1

The depth of understanding of the courses studied by the students will be evaluated by a panel of faculty.

08M711 MANUFACTURING SYSTEMS LABORATORY

0 0 2 1

1. Solving LPP, Transportation, assignment problems using Excel solver.
2. Solving inventory, scheduling lot sizing problems using manufacturing systems simulation software
3. Solving queuing problem and layout optimization using manufacturing systems simulation software
4. Project evaluation and review based on time and cost
5. Weibull reliability plot creation using component / product failure data
6. Line balancing using manufacturing systems simulation software
7. Current state and future state mapping using value stream mapping software
8. Process capability studies using statistical software
9. Analysis of DoE results using statistical software
10. Materials / process planning using ERP package
11. 5S practice / Poke Yoke for workplace improvement
12. Use of DFA software for evaluation of product design alternatives from assembly consideration.

REFERENCE:

1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER 9

08M701 ENVIRONMENTAL SCIENCE AND ENGINEERING

(Also common with 08L602/ 08Z602/ 08I602/ 08D602/08M701/ 08E701/ 08P701/ 08Y701/ 08T701/ 08A701/ 08B701)

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 Ecosystem – Structure and function – Ecological succession – Introduction to various ecosystems. Biodiversity – Definition and types – Threats to Biodiversity in India and its impacts – Conservation of Biodiversity. – Wildlife Protection Act - Forest Conservation Act. (8)

AIR POLLUTION AND CONTROL: Introduction – atmospheric constituents – Chemical reaction in the atmosphere – air pollutants – classification – effects on human, animal, plant, property and environment – control methods for particulates and gaseous pollutants – acid rain - control of pollutants from automobiles – Burning of plastics – PCBs and their impact. (6)

GLOBAL ENVIRONMENTAL ISSUES: Green house gases – green house effects - climate change - global warming and its effects – international climate conventions, protocols and perspectives – technology and policy options for GHG emission mitigation -ozone layer depletion and solutions. (6)

WATER POLLUTION AND CONTROL: Sources – characteristics – BOD, COD - pollutants and their effects – heavy metal pollution – inorganic and organic pollutants control methods – screening, sedimentation, biological processes - working and design principles – advanced waste water treatment techniques - self purification of rivers – eutrophication of lakes – sludge management. (8)

OTHER ENVIRONMENTAL POLLUTIONS: Definition – Causes, effects and control measures of: Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial solid wastes - Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water Act – Introduction to EIA and ISO 14000 (8)

SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management - Population growth, variation among nations – Population explosion - Environment and human health – Role of Information Technology in Environment and human health - Disaster management: floods, earthquake, cyclone and landslides (6)

Total 42

TEXT BOOKS:

1. Santhosh Kumar Garg, Rajeswari Garg and Ranjani Garg, "Environmental Science and Ecological Studies", Khanna Publishers, Second Edition, New Delhi, 2007.
2. Deswal S and Deswal A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, First Edition, Delhi, 2004
3. Kurian Joseph and Nagendran R, "Essentials of Environmental Studies", Pearson Education Pvt Ltd., First Edition, Delhi, 2004

REFERENCES:

1. Gilbert M Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt. Ltd., Second Edition, 2004.
2. Cunningham, Cooper W P and Gorhani T H, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Tivedi R K, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media., 1998
4. Wager K D, "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
5. <http://www.ipcc.ch/index.htm>
6. <http://unfccc.int/2860.php>

08M720 PROJECT WORK I

0 0 6 3

- ❖ 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

SEMESTER 10

08M820 PROJECT WORK II

0 0 24 12

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

ELECTIVES

MATHEMATICS

08O001 APPLIED NUMERICAL ANALYSIS

3 1 0 3.5

TYPES OF ERRORS: Different types of errors

(2)

SOLUTION OF ALGEBRAIC EQUATIONS: Newton Raphson method, Modified Newton Raphson method, Method of false position, Graffe's root squaring method, Bairstow's method.

(6)

OPTIMIZATION: One dimensional unconstrained optimization-Golden-Section search, Quadratic Interpolation, Newton's method.

(2)

SOLUTION OF ALGEBRAIC SIMULTANEOUS EQUATIONS: Gauss – Jordan elimination, Cholesky method, Crout's method, Gauss – Jacobi method, Gauss – Seidel method. Matrix Inverse by Gauss – Jordan method.

(5)

EIGENVALUES AND EIGENVECTORS: Power method for finding dominant eigenvalue and inverse power method for finding smallest eigenvalue, Jacobi method for symmetric matrices.

(3)

FINITE DIFFERENCES AND INTERPOLATION: Finite difference operators – $E, \Delta, \nabla, \delta, \mu, D$. Interpolation-Newton-Gregory forward and backward interpolation, Lagrange's interpolation formula, Newton divided difference interpolation formula. Solution of linear second order difference equations with constant coefficients.

(8)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation using Newton-Gregory forward and backward polynomials. Numerical Integration-Gaussian quadrature, Trapezoidal rule and Simpson's one third rule.

(5)

ORDINARY DIFFERENTIAL EQUATIONS: Taylor series method, Euler and Modified Euler method, (Heun's method). Runge-Kutta method, Milne's method, Adams-Moulton method, Solution of boundary value problems of second order by finite difference method.

(6)

PARTIAL DIFFERENTIAL EQUATIONS: Classification of partial differential equations of second order. Liebmann's method for Laplace equation and Poisson equation, Explicit method and Crank – Nicolson method for parabolic equations. Explicit method for hyperbolic equations.

(5)

MATLAB: Matlab – Tools kits – 2D Graph plotting, 3D Graph plotting, Data analysis.

Total 42

REFERENCES:

1. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers with Software and Programming Applications", Tata McGraw Hill, 2004.
2. John H Mathews and Kurtis D Fink, "Numerical Methods using MATLAB", Prentice Hall, 2004.
3. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, 2002.
4. Rober J Schilling and Sandra L Harries, "Applied Numerical Methods for Engineers using MATLAB and C", Thomson Brooks/Cole, 1999

08O002 BUSINESS STATISTICS

3 1 0 3.5

FREQUENCY DISTRIBUTION: Grouping and Displaying data to convey meaning – Tables and graphs – Measures of central tendency and dispersion in frequency distributions.

(6)

PROBABILITY DISTRIBUTIONS: Types of Probability – Probability rules – Probabilities under conditions of Statistical independence and dependence – Baye's theorem – Binomial, Poisson, Geometric, Exponential and Normal Distributions.

(8)

SAMPLING AND SAMPLING DISTRIBUTIONS: Random Sampling – Design of Experiments – Sampling Distributions – Sampling - Sample size and standard error. (6)

ESTIMATION: Introduction -Point Estimates- interval Estimates – Basic Concepts – Interval Estimates and Confidence Intervals – Calculating Interval Estimates of the Mean from Large Samples – Calculating Interval estimates of the Proportion from Large samples – Interval Estimates using the t Distribution – Determining the sample size in estimation. (6)

TESTING OF HYPOTHESES: One sample tests – Introduction – Concepts Basic to the Hypothesis – Testing Procedure – Testing Hypotheses – Hypothesis Testing of Means - Population Standard Deviation – Measuring the power of a Hypothesis test – Hypothesis Testing of Proportions – Large Samples – Hypothesis Testing of Means. (6)

REGRESSION AND CORRELATION: Estimation using the Regression Line – Correlation Analysis – Making Inferences about population parameters – Using Regression and correlation analyses – Limitations. Errors and Caveats - Multiple Regression and Correlation Analysis – Finding the Multiple – Regression Equation - The Computer and Multiple Regression – Making Inferences about Population Parameters – Modeling Techniques. (6)

TIME SERIES AND FORECASTING: Variations in Time Series – Trend Analysis – Cyclical Variation – Seasonal Variation – Irregular Variation – A Problem Involving all Four Components of a Time Series – Time Series Analysis in Forecasting. (4)

Total 42

REFERENCES:

1. Paul Newbold, William Carlson and Betty Thorne, "Statistics for Business and Economics", Pearson Education, 2007.
2. Richard I Levin and David S Rubin, "Statistics for Management", Pearson Education, 2005.
3. Mark Berenson, Timothy Krehbiel and David Levine, "Basic Business Statistics", Pearson Education, 2005.

08O003 MATHEMATICAL MODELING

3 1 0 3.5

INTRODUCTION TO MODELING: Modeling process, Overview of different kinds of models. (2)

EMPIRICAL MODELING WITH DATA FITTING: Error functions, least squares; fitting data with polynomials and splines. (4)

QUALITATIVE MODELING WITH FUNCTIONS: Modeling species propagation, supply and demand, market equilibrium, market adjustment. Inventory Models- Various types of inventory models with shortage and without shortage, Probabilistic Models. (10)

CAUSAL MODELING FORECASTING: Introduction, Modeling the causal time series, forecasting by regression analysis, prediction by regression. Planning, development and maintenance of linear models, trend analysis, modeling seasonality and trend. (8)

DECISION MAKING: Decisions under un certainty, under certainty, under risk –Decision trees- Expected value of perfect information and imperfect information. (8)

MODELING WITH SIMULATION: Principles of Computer modeling and simulation, Monto-Carlo Simulation, Limitation of Simulation, areas of application, discrete and continuous systems, variety of modeling approaches. Techniques of Random number generation- Midsquare method, midproduct method, Constant multiplier technique, additive congruential method, linear congruential method. Tests for random numbers- The Kolmogorov –Simmov test- The chi-square test. (10)

Total 42

REFERENCES:

1. Hamdy A Taha, "Operation Research", Pearson Education, 2002.
2. Jerry Banks, John S Carson and Barry L Nelson, "Discrete Event system Simulation", Prentice Hall, 2002.
3. Edward A Bender, "An Introduction to Mathematical Modeling", Dover, 2000.
4. Averil M Law and W David Kelton W, "Simulation modeling and Analysis", Tata Mc-Graw Hill,2000.
5. Giordano F R, Weir M D and Fox W P, " A First Course in Mathematical Modeling" Brooks/ Cole 1997.

08O004 OPTIMIZATION TECHNIQUES

3 1 0 3.5

INTRODUCTION: Statement of an optimization problems – classification of optimization problem – classical optimization techniques; Single variable optimizations, Multi variable optimization, equality constraints, Inequality constraints, No constraints. (3)

LINEAR PROGRAMMING: Graphical method for two dimensional problems – central problems of Linear Programming – Definitions – Simplex – Algorithm – Phase I and Phase II of Simplex Method – Revised Simplex Method. (6)

Simplex Multipliers – Dual and Primal – Dual Simplex Method – Sensitivity Analysis – Transportation problem and its solution – Assignment problem and its solution by Hungarian method – Karmakar's method – statement, Conversion of the Linear Programming problem into the required form, Algorithm. (7)

NON LINEAR PROGRAMMING (ONE DIMENSIONAL MINIMIZATION): Introduction – Unrestricted search – Exhaustive search – Interval halving method – Fibonacci method. (5)

NON LINEAR PROGRAMMING : (UNCONSTRAINED OPTIMIZATION): – Introduction – Random search method – Uni variate method – Pattern search methods – Hooke and Jeeves method, Simplex method– Gradient of a function – steepest descent method – Conjugate gradient method. (7)

NON LINEAR PROGRAMMING – (CONSTRAINED OPTIMIZATION): Introduction – Characteristics of the problem – Random search methods – Complex method. (5)

DYNAMIC PROGRAMMING: Introduction – multistage decision processes – Principles of optimality – Computation procedures. (5)

DECISION MAKING: Decisions under uncertainty, under certainty and under risk – Decision trees – Expected value of perfect information and imperfect information. (4)

Total 42

REFERENCES:

1. Kalyanmoy Deb, "Optimization for Engineering Design, Algorithms and Examples", Prentice Hall, 2004.
2. Hamdy A Taha , "Operations Research – An introduction", Pearson Education , 2002.
3. Hillier / Lieberman, "Introduction to Operations Research", Tata McGraw Hill Publishing Company Ltd, 2002.
4. Singiresu S Rao, "Engineering Optimization Theory and Practice", New Age International, 1996.
5. Mik Misniewski, "Quantitative Methods for Decision makers", MacMillian Press Ltd., 1994.
6. Kambo N S, "Mathematical Programming Techniques", Affiliated East – West Press, 1991.

08O005 STATISTICAL QUALITY CONTROL

3 1 0 3.5

PROBABILITY, RANDOM VARIABLES, THEORETICAL DISTRIBUTIONS: Axiomatic approach to probability – Random variables, Discrete random variables: Bernoulli, Binomial, Geometric and Poisson distributions, Continuous random variables: Uniform, Exponential, Normal distributions, Applications. (6)

THEORY OF ATTRIBUTES: Classes and class frequencies – Consistency of data – Independence of attributes – Association of attributes, Yule's coefficient of Association – Coefficient of colligation. (5)

ESTIMATION: Point estimation – Characteristics of estimation – Methods of estimation – Interval estimation – Interval estimates of mean, standard deviation, proportion, difference in means and ratios of standard deviation. (6)

TESTING OF HYPOTHESIS AND ANALYSIS OF VARIANCE: Large Sample Tests – Tests for means, variances and proportions. Small Sample Tests – Tests for means variances and attributes. Design of Experiments – ANOVA, completely randomized design, Randomized block design, Latin square design. (8)

STATISTICAL QUALITY CONTROL: Statistical basis for control charts – control limits – control charts for variables – charts for defective – charts for defects. (6)

SAMPLING AND ACCEPTANCE SAMPLING BY ATTRIBUTES: Single sampling plan – Double sampling plan – Multiple sampling plan – Type A and Type B OC curves, consumer's risk, producer's risk. ASN, ATI, AOQ curves MIL-STD-105D sampling plans. (5)

CONCEPT OF RELIABILITY, HAZARD RATE AND MEAN TIME TO FAILURE: Mathematical models for reliability studies – Normal, Exponential and Weibull failure laws. System failure rate, system mean time to failure, Series system, Parallel system, (k,n) system, Series-Parallel system. (6)

Total 42

REFERENCES:

1. Jay L Devore, "Probability and Statistics for Engineering and Sciences", Thomson Duxbury, 2007.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", John Wiley and Sons, 2006.
3. Sheldon Ross, "A First course in Probability", Pearson Education, 2005.
4. Dale H Besterfield, "Quality Control", Prentice Hall, 2003.
5. Charles E Ebeling, " An Introduction to Reliability and Maintainability Engineering", McGraw Hill, 2000.

08O006 STOCHASTIC MODELS

3 1 0 3.5

PROBABILITY AND CONCEPT OF RANDOM VARIABLE: Concepts of Probability – Conditional Probability – Independent Events – Baye's Theorem - Random Variables – Jointly Distributed Random Variables – Expectations of Random Variables – Conditional Expectations. (8)

PROBABILITY DISTRIBUTIONS AND APPLICATIONS: Discrete Distributions: Binomial, Poisson and Geometric. Continuous Distributions: Uniform, Exponential, Normal, Weibull and Erlang distributions – MGF-Mean and Variance. (8)

STOCHASTIC PROCESSES: Introduction – Classification of Stochastic Processes – Markov Chain: Introduction -Transition Probability Matrices – Chapman Kolmogorov Equations - Classification of Sates – Limit Theorems – Applications. (9)

CONTINUOUS TIME MARKOV CHAINS: Introduction – Poisson Process - Birth and Death Processes – Kolmogorov Differential Equations – Pure Birth Process - Pure Death Process - Applications. (7)

QUEUEING THEORY: Introduction – Characteristics – Steady State Solution: M/M/1, M/M/c, M/M/c/k Models- Queues with unlimited Service – Open Queuing Networks – Closed Queuing Networks – Cyclic Queues – Applications. (10)

Total 42

REFERENCES:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", Prentice Hall, 2005.
2. Sheldon M Ross, "Stochastic Processes", John Wiley & Sons, Inc., 2004.
3. Sheldon M Ross, "Introduction to Probability Models", Academic Press, 2003.
4. Medhi J, " Stochastic Processes", New Age International Publishers , 2002.
5. Samuel Karlin and Howard E Taylor, "A First course in Stochastic Processes", Academic Press, 2002
6. D.L.(Paul) Minh, "Applied Probability Models", Duxbury Thomson Learning, 2002
7. Gross.D and Harrish C M, "Fundamentals of Queuing Theory", John Wiley & Sons, New Delhi, 1998

08O007 DATABASE SYSTEMS

3 1 0 3.5

INTRODUCTION: Purpose of Database system - Characteristics of database approach - Advantages of using DBMS - Database concept and architecture - Data Abstraction - Data Models - Instances and schema - Data independence - schema architecture - Database Languages - Database Manager - Database Administrator - Database Users. (6)

DATA MODELING: Entity sets attributes and keys - Relationships (ER) - Database modeling using entity - Type role and structural constraints - Weak and Strong entity types - Enhanced entity-relationship (EER) - Entity-Relationship Diagram Design of an E-R Database schema – Object modeling - Specialization and generalization - Modeling of union types. (5)

RELATIONAL MODEL: Relational model -basic concepts - Enforcing Data Integrity Constraints – Relational Algebra Operations - Extended Relational Algebra Operations - Relational Calculus - Assertion and Triggers - Introduction on views - Introduction to SQL – Basic queries in SQL - Advanced queries in SQL - Functions in SQL - Basic data retrieval - Aggregation – Categorization - Updates in SQLs - Views in SQL - Different types of views - Theoretical Updatability of Views. (8)

DATABASE DESIGN: Database design process - Relational database design - Relation Schema - Anomalies in a database - Functional dependencies - Membership and minimal covers - Normal forms - First Normal Form - Second Normal Form - Third Normal Form - Boyce-Codd Normal form - Reduction of an E-R schema to Tables - Converting EER Diagrams to relations - Practical database design tuning - Effect of de-normalization on database performance. (8)

FILE ORGANIZATION, INDEXING AND HASHING: Overview of file organization techniques - Secondary storage devices - Operations in files - Heap files and sorted files - Basic concepts Indexing and Hashing – Basics of RAID technology. (6)

OBJECT ORIENTED DATABASE DESIGN: Introduction OODBMS - Approaches to OODs - Object oriented data model - Object identity - Complex Objects - Persistence - Type and class hierarchies - Inheritance - Modeling and designing of OODs – OODBMS for CAD / CAM application. (6)

CASE STUDY ON POPULAR DATABASE PACKAGES: Oracle – Implementation of CAD / CAM design data in Oracle database. (3)

Total 42

REFERENCES:

1. Date C J, "An Introduction to Database Systems", Pearson Education Asia, 2005.
2. Elmasri R and Navathe S B, "Fundamentals of Database Systems", Addison Wesley, 2004.
3. Raghu Ramakrishnan, "Database Management Systems", Mc Graw Hill, 2004.
4. Silberschatz, Korth H and Sudharshan S, "Database System Concepts", Mc Graw Hill, 2003.
5. Graeme C Simsion, "Data Modeling Essentials", Dreamtech, 2001.

08O008 MATHEMATICAL MODELING FOR MECHANICAL SCIENCES

3 0 0 3

INTRODUCTION: General consideration of modeling: Basic concepts of fluid flow, derivation of the governing equations, conservation of mass, momentum, numerical methodology, discrimination, grid formation. (7)

FLUID DYNAMICS: Properties of fluids, basic concepts, Types of flow, continuity equation, derivation of three dimensional equations, momentum equation, Navier Stoke's equation, Euler's equation, Bernoulli's energy equation - Boundary layer theory, Introduction to computational fluid dynamics, FEM and FVM techniques, applications of fluid Dynamics. (14)

FLOW MODELING: Laminar flow between plates, Covette, and plane Poiseuille, Turbulence energy equation-one equation model, the $K - \omega$ model, the $K - \xi$ model. (11)

MATHEMATICAL MODELS: Modeling free vibration, the classical equations, the vibrating string membrane, waves in an elastic medium, conduction of solids in the circular membrane, the gravitational potential, some problems. (10)

Total 42

REFERENCES:

1. Pieter Wesseling, "Principles of Computational Fluid Dynamics", Springer, 2004.
2. Chung T.J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002

3. David C. Wilcox, "Turbulence Modeling for Computational Fluid Dynamics", DCW Industries, Inc, 1993
4. Batchelor G.K, "Fluid Dynamics", Cambridge University Press, 1993

PHYSICS

080016 MICRO MACHINING AND MICRO SENSORS

3 0 0 3

MEMS AND MICROSYSTEMS: MEMS and microsystem products. Evaluation of microfabrication. Microsystems and microelectronics. Applications of microsystems. Working principles of microsystems - microsensors, micro actuators, MEMS and microactuators, microaccelerometers. (5)

SCALING LAWS IN MINIATURIZATION: Introduction. Scaling in geometry. Scaling in rigid body dynamics. The Trimmer force scaling vector – scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. (5)

MATERIALS FOR MEMS AND MICROSYSTEMS: Substrates and wafers. Silicon as a substrate material. Ideal substrates for MEMS. Single crystal Silicon and wafers crystal structure. Mechanical properties of Si. Silicon compounds - SiO₂, SiC, Si₃N₄ and polycrystalline Silicon. Silicon piezoresistors. Gallium arsenide. Quartz – piezoelectric crystals. Polymers for MEMS. Conductive polymers. (8)

MICROSYSTEM FABRICATION PROCESS: Photolithography. Photoresist and applications. Light sources. Ion implantation. Diffusion process. Oxidation – thermal oxidation. Silicon diode. Thermal oxidation rates. Oxide thickness by colour. Chemical vapour deposition – principle, reactants in CVD. Enhanced CVD physical vapour deposition. Sputtering. Deposition by epitaxy. Etching – chemical and plasma etching. (8)

MICRODEVICES: Sensors – classification of sensors – signal conversion – ideal characterisation of sensors – mechanical sensors – measurands – displacement sensors – pressure and flow sensors. (8)

MICROMANUFACTURING AND MICROSYSTEM PACKAGING: Bulk micromachining. Isotropic and anisotropic etching - wet etchants, etch stops, dry etching comparison of wet and dry etching. Dry etching – physical etching – reactive ion etching, comparison of wet and dry etching. Surface micromachining - process in general, problems associated in surface micromachining. The LIGA process – description, materials for substrates and photoresists, electroplating, the SLIGA process. Microsystem packaging - General considerations. The three levels of microsystem packaging – die level, device level and system level. Essential packaging technologies – die preparation – surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of microsystem – selection of packaging materials. (8)

Total 42

REFERENCES:

1. Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Mark Madou "Fundamentals of Microfabrication", CRC Press, New York, 1997.
3. Julian W Gardner, "Microsensors: Principles and Applications", John Wiley and Sons, New York, 2001.
4. Sze S M, "Semiconductor Sensors", McGraw Hill, New York, 1994.
5. Chang C Y and Sze S M, "VLSI Technology", Mc Graw Hill, New York, 2000.
6. Kovacs G T A, "Micromachined Transducers Sourcebook", McGraw Hill, New York, 1998.

080017 NANO SCIENCE AND TECHNOLOGY

3 0 0 3

INTRODUCTION AND CLASSIFICATION: Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. (8)

NANOMATERIALS AND CHARACTERIZATION: Fabrication methods – Top down processes – Milling, lithographics, machining process – Bottom-up process – Vapour phase deposition methods, plasma-assisted deposition process, MBE and MOVPE, liquid phase methods, colloidal and solgel methods – Methods for templating the growth of nanomaterials – Ordering of nanosystems, self-assembly and self-organisation – Preparation, safety and storage issues. (8)

GENERIC METHODOLOGIES FOR NANOTECHNOLOGY: Characterisation: General classification of characterisation methods – Analytical and imaging techniques – Microscopy techniques - Electron microscopy, scanning electron microscopy, transmission electron microscopy, STM, field ion microscopy, scanning tunnelling microscopy, atomic force microscopy – Diffraction techniques – Spectroscopy techniques – Raman spectroscopy – Surface analysis and depth profiling – Mechanical properties, electron transport properties, magnetic and thermal properties. (8)

INORGANIC SEMICONDUCTOR NANOSTRUCTURES: Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, lithography and etching, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques. (6)

SELF ASSEMBLING NANOSTRUCTURED MOLECULAR MATERIALS AND DEVICES: Introduction – Building blocks – Principles of self-assembly, non-covalent interactions, intermolecular packing, nanomotors – Self assembly methods to prepare and pattern nanoparticles – Nanoparticles from micellar and vesicular polymerization, functionalized nano particles, colloidal nanoparticles crystals, self-organizing inorganic nano particles, bio-nanoparticles – nanoobjects. (6)

NANODEVICES AND THEIR VARIOUS APPLICATIONS: Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Magneto resistance – Probing nanomagnetic materials – Nanomagnetism in technology – Carbon nanotubes – fabrication- applications – Organic FET, organic LED's – Organic photovoltaics – Injection lasers, quantum cascade lasers, optical memories, electronic applications, colulomb blockade devices. (6)

Total 42

REFERENCES:

1. Kelsall Robert. W, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", Wiley Eastern, 2004.
2. Gregory Timp, "Nanotechnology", Springer-Verlag, 1999.
3. Charles P Poole, Frank J Owens, "Introduction to Nanotechnology", John Wiley and Sons, 2003.
4. Bharat Bhushan, "Springer Handbook of Nanotechnology", 2004.
5. Michael Kohler, Wolfgang, Fritzsche, "Nanotechnology: Introduction to Nanostructuring Techniques", 2004.
6. Mark Ratner, Danial Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Pearson, 2003.
7. William Goddard, Donald W Brenner, "Handbook of Nano Science Engineering and Technology", CRC Press, 2004.

08O018 INTEGRATED CIRCUIT TECHNOLOGY

3 0 0 3

INTEGRATED CIRCUITS: Monolithic integrated circuits - origin of silicon and its purification - crystal growth, doping, wafer manufacture, crystal orientation, growth of silicon dioxide, oxidation process, oxide evaluation, thickness, contamination and oxidation reaction. (8)

EPITAXIAL DEPOSITION: Reactor - growth sequence, evaluation - impurity introduction and redistribution, diffusion – definition, process, mathematical analysis of diffusion, evaluation, ion implantation and its evaluation - non epitaxial CVD process. (8)

PHOTOLITHOGRAPHY: Process overview – photoresist, process sequence, photomasks, wafer fabrication environment, chemicals and cleaning procedures, particle monitoring technology personal and clean room procedures. (9)

IC RESISTORS: Sheet resistance, geometrical factors, diffused resistors, tolerance, temperature coefficient, pinch resistors, thin and thick film resistors, IC capacitors, oxide capacitors, junction capacitors, thin and thick film capacitors. (9)

IC TRANSISTORS: NPN transistors, current gain, breakdown voltage, saturation voltage and resistance, leakage currents, noise, frequency response, switching transistors, PNP transistors, diodes, Zener diodes, Schottky barrier diodes, Maximum voltage, current, power and frequency. (8)

Total 42

REFERENCES:

1. Peter Gise and Richard Blanchard,- "Modern Semiconductor Fabrication Technology", Prentice Hall, 1986.
2. Hans R Camenzind, "Electronic Integrated Systems Design", Van Nostrand Reinhold Co.,1972.
3. John Allison, "Electronic Integrated Circuits-Their Technology and Design", McGraw Hill, 1975

08O019 THIN FILM TECHNOLOGY

3 0 0 3

EVAPORATION THEORY: Cosine law of emission. Emission from a point source. Mass of material condensing on the substrate. (3)

PREPARATION OF THIN FILMS: Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization. Physical methods: Vacuum evaporation - Study of thin film vacuum coating unit - Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Arc and Laser evaporation. Sputtering - Study of glow Discharge - Physical nature of sputtering - Sputtering yield - Experimental set up for DC sputtering, AC sputtering and RF sputtering. Nucleation and growth of thin films (qualitative study only): Four stages of film growth. (9)

DEPOSITION MONITORING AND CONTROL: Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. **Thickness measurement:** Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only). (8)

ELECTRICAL PROPERTIES: Sheet resistance - size effect - Electrical conduction in thin metallic films. Effect of Ageing and Annealing - Oxidation - Agglomeration. (5)

DIELECTRIC PROPERTIES: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity. (7)

OPTICAL PROPERTIES: Optical constants and their determination - Spectrophotometer method. Antireflection coatings. Interference filters. Thin film Solar Cells CuInSe_2 solar cell. (5)

APPLICATION OF THIN FILMS: Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area) - Trimming of thin film resistors - sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials - Capacitor structures - Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics - Thin film diodes. (5)

Total 42

REFERENCES:

1. Maissel L.I and Glang R, "Hand Book of Thin Film Technology", McGraw Hill, 1970.
2. Chopra K L, "Thin Film Phenomena", Mc Graw Hill, 1969.
3. Berry R W and others, "Thin Film Technology", Mc Graw Hill Company, 1970.
4. Heavens O S, "Thin Film Physics", Butter worths scientific publications, 1955.
5. Anders H, "Thin Films in Optics", Focal press, 1967.
6. Schwartz B and Schwartz N, "Measurement Techniques for Thin Films", John Wiley and Sons, 1967.
7. Guthrie A, "Vacuum Technology" John Wiley and Sons, 1963.
8. Holland L, "Vacuum Deposition of Thin Films", Chapman and Hall, 1956.
9. Rao V V, Ghosh, T.B., Chopra, K.L., "Vacuum Science and Technology", Allied Publications, 1998.
10. Goswami A, "Thin Film Fundamentals", New Age International (P) Ltd., 1996.
11. Aicha Elshabini-Riadaud Fred D Barlow III, "Thin Film Technology Hand Book", Mc Graw Hill Company, 1997.

08O020 LASER TECHNOLOGY

3 0 0 3

EMISSION AND ABSORPTION OF RADIATION: Einstein coefficients - negative absorption, shape and width of spectral lines, spontaneous and stimulated emission. (6)

THRESHOLD CONDITION: Rate equations - optical excitation in three and four level lasers, standing waves in a laser, cavity theory, modes, diffraction theory of the Fabry - Perot interferometer. (6)

LASERS WITH SPHERICAL MIRRORS: Types of resonators, stability diagram - coherence - spatial and temporal. (5)

LASER MATERIALS: Activator and host materials for solid lasers - growth techniques for solid laser materials - Bridgman and Stock-Berger technique - Czochralski and Kyropoulous techniques. (5)

TYPES OF LASERS: (A) Gas lasers - He-Ne laser - Ar⁺, He-Cd⁺ lasers - N₂ and CO₂ lasers - Fabrication and excitation mechanisms. **(B)** Liquid lasers, dye lasers, fabrication and excitation mechanisms. **(C)** Solid lasers - Ruby, Nd:YAG, glass - semiconductor diode lasers, Excimer Laser , Erbium doped laser. (9)

LASER Q SWITCHING: Mode-locking, second harmonic generation, theory and experiment, materials for optical SHG. (6)

APPLICATIONS: Laser communications, holography, industrial applications: cutting, drilling & welding, medical. Spectroscopic (qualitative), laser Raman effect, stimulated Raman effect - Brillouin scattering. (5)

Total 42

REFERENCES:

1. Lengyel B A, "Lasers", Wiley-Inter Sci., 1971.
2. Marshall S L, "Laser Technology and Applications", McGraw Hill Book Co., 1980.
3. Bloom A L, "Gas Lasers", John Wiley & Sons Inc., New York, 1968.
4. Sona, Gordan and Breach, "Lasers and Applications", Scientific Publishers Inc., New York, 1976.

08O021 COMPOSITE MATERIALS

3 0 0 3

INTRODUCTION: Reinforcement – Fibres – Glass fibre, Aramid fibre, Carbon fibre, boron fibre – Fabrication – Properties – Applications – Comparison of fibres – Particulate and whisker reinforcements. Matrix materials – Properties. (7)

REINFORCEMENT – MATRIX INTERFACE: Wettability – Effect of surface roughness – Interfacial bonding – Methods for measuring bond strength. (5)

POLYMER MATRIX COMPOSITES: Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrusion, resin transfer moulding, autoclave moulding – Thermoplastic matrix composites – Injection moulding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications. (7)

METAL MATRIX COMPOSITES: Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, insitu. Sic fibre / Titanium interface. Mechanical properties. Applications. (6)

CERAMIC MATRIX COMPOSITES: Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – CVD, CVI, sol gel process. Interface in CMCs. Mechanical properties – Thermal shock resistance – Applications. (7)

GEOMETRICAL ASPECTS: Unidirectional laminas – Volume fraction and weight fraction – Woven roving, in-plane random fibres – Fibre length and fibre orientation distribution – Voids – Fibre orientation during flow. (5)

FATIGUE AND CREEP IN COMPOSITE MATERIALS: Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue – Creep. (5)

Total 42

REFERENCES:

1. Krishnan K Chawla, "Composite Materials Science and Engineering", Springer, 2001.
2. Mathews F L and Rawlings R D, "Composite Materials: Engineering and Science", CRC Press and Woodhead Publishing Limited, 2002.
3. Derek Hull, "An introduction to Composite Materials", Cambridge University Press, 1988.
4. Handbook of Composites – American Society of Metals, 1990.

080022 ELECTRONIC CERAMICS

3 0 0 3

STRUCTURE OF CERAMIC MATERIALS: Pauling's rule – Oxide structures Silicate structures – Clay minerals – polymorphism: displacive transformations, reconstructive transformation, Silica. (8)

STRUCTURE OF GLASSES: Glass formation – Random network model – structure of oxide glasses – glass formation – composition as a variable, heat flow and precipitation from glasses – growth controlled by diffusion of solutes – crystalline glasses – enamels – photosensitive and photochromic glasses. (9)

OUTLINE OF ELECTRICAL PROPERTIES: Conductivity of ceramic materials – ceramic semiconductors and their uses as fixed resistors, heating elements, thermistors and varistors – piezoelectric ceramics – insulators. (6)

DIELECTRIC MATERIALS: Electronic, ionic, orientation and space charge polarization mechanisms. Electrical properties such as capacitive loss, dielectric conductivity and dielectric strength. Structural dielectric materials. Ferroelectric theory, ferroelectric state based on local field. Effects of temperature, environment, composition and grain size. Anti-ferroelectric and ferroelectric transition. (8)

PIEZOELECTRIC CERAMICS: Parameters for piezoelectric ceramics and measurement. General characteristics and fabrication of PZT. Applications. (5)

ELECTRO-OPTIC CERAMICS: Birefringence. Non-linear effects in large electric fields. Pockels effect. Kerr effect. Second harmonic generation. Measurement of electro-optic properties - Applications. (6)

Total 42

REFERENCES:

1. Kingery, "Introduction to Ceramics", John Wiley Publications, 1991.
2. Van Vlack, "Physical Ceramics for Engineers", Addison Wesley, 1964.
3. Moulson A J and Herbert J M, "Electro Ceramics", Ed. 2, John Wiley and Sons Ltd., 2003.
4. William F Smith, "Foundations of Materials science and Engineering", McGraw Hill Book Co., 2000.
5. Michel W Barsoum, "Fundamentals of Ceramics", McGraw Hill Book Co., 1997.

080023 PLASMA TECHNOLOGY

3 0 0 3

DISCHARGE PHYSICS AND GLOW DISCHARGE: Types of Discharges: AC and DC discharges - glow - arc - corona - rf - ecr discharges - conduction in ionized gases. Diffusion: Diffusion and mobility - mean free path and collision frequency - free diffusion - mobility - ambipolar diffusion - transition diffusion - diffusion in magnetic field and fully ionized plasma. General structures and features: V-I characteristics - cathode layer - positive column - discharge in fast gas flow - glow discharge instabilities and their consequences - thermal stability. (10)

ARC DISCHARGE: Definition and characteristics - features of arc discharge - types of arcs, high intensity arcs - classification of arcs- free burning arc - wall, vortex, electrode, forced convection and magnetically stabilized arcs - Non thermal arcs; low pressure and low intensity arcs - initiation of arcs - low pressure arc with externally heated cathode - plasma temperature - V-I characteristics - electron and gas temperatures. (8)

Thermally induced random motion of particles - distribution of temperature and velocity in a gas - ionization of atoms and molecules - Saha equation - degree of ionization - electron concentration - thermodynamic equilibrium of plasma in an electrical discharge - definition of thermodynamic properties of plasma. (7)

LABORATORY PLASMA SOURCES/DEVICES: Low temperature plasma generation - transferred and non-transferred arc torches and their characteristics - heat transfer efficiency of plasma torches - design accepts - special type of torch for metallurgical applications - vacuum plasma torches - rf torch and their characteristics. (7)

APPLICATIONS: Plasma spraying of ceramic, alloys and metals - vacuum spraying - plasma reduction of ores and minerals - plasma disassociation of compound oxides - plasma refining and remelting - plasma furnace in steel making - plasma cutting - sputtering - plasma enhanced chemical vapour deposition - plasma nitriding and surface cleaning. (7)

PLASMA DIAGNOSTICS: Electrical probe techniques - spectroscopic methods - charged particle methods - energy balance technique. (3)

Total 42

REFERENCES:

1. Yuri P Raizer, "Gas Discharge Physics", Springer – Verlag, Berlin, 1991.
2. Plasma Metallurgy, "The principles of materials science monographs", 23, Vladimir Dembovsky, Elsevier Science, Jan. 1985.
3. Lochite W and Holtgrevan, "Plasma Diagnostics", North Holland Publishing Company, 1968.
4. "Plasma Physics and Controlled Nuclear Fusion Research", Vol.1,2 & 3, IAEA Publication.
5. Dresvin S V and Donskoi A V, "Physics and Technology of Low Temperature Plasmas", John Wiley and Sons, 1977.
6. Taritkumar Bose, "High Temperature Gas Dynamics", Springer, 2004.
7. Francis F Chen, "Introduction to Plasma Physics", Plenum press (New York), 1984.
8. George Schmidt, "Physics of High Temperature Plasma", Academic press, New York, 1979.
9. "Plasma Processing and Synthesis of Materials", Materials Research Society Symposia Proceedings, Vol. 30.
10. Brown S C, "Introduction to Electrical Discharge in Gases", John Wiley, New York, 1996.
11. Rosnagel S M, Cuomo J J and Westwood W D, "Handbook of Plasma Processing Technology", William Andrew Publishing, 1990.

080024 COMPUTATIONAL MATERIALS SCIENCE

3 0 0 3

INTRODUCTION: Introduction: Simulation as a tool for materials science, Modelling of Natural phenomena.– Types of models: Quantum mechanical, atomistic, mesoscopic, continuum – Multiscale approaches. (7)

ELEMENTS OF DIFFERENTIAL EQUATIONS: Differential equations in discrete and continuum simulation methods – Ordinary differential equations for particle dynamics, partial differential equations, condition / diffusion equation. (6)

EMPIRICAL METHODS AND COARSE GRAINING : Introduction - Reduction to classical potentials – polar systems, Vander Waals potential, potential for covalent bonds , Embedded-atom potential. The Connolly – Williams, approximation – Lattice gas model, Connolly Williams approximation; Potential renormalization. Basic idea; Two step renormalization scheme. The first step, second step and applications to Si. (8)

MONTE CARLO METHODS: Introduction to probability and statistics – Basics of the Monte Carlo method – Stochastic processes, Markov process and Ergodicity. Algorithms for Monte Carlo simulation – Random Numbers, simple sampling technique, importance of sampling technique, General comments on dynamic models. Applications to systems of classical particles, modified Monte Carlo techniques, percolation and polymer systems. (8)

APPLICATIONS OF MONTE-CARLO: Random walk, self-avoiding walk. Classical spin system- Ising model, Nucleation, crystal growth, Fractal system. (6)

QUANTUM MONTE CARLO (QMC) METHODS: Introduction - Variational Monte Carlo methods, Diffusion Monte Carlo method, path integral Monte Carlo method, Quantum spin models and other Quantum Monte Carlo methods. (7)

Total 42

REFERENCES:

1. Ohno K, Esfarjani K and Kawazoe Y, "Introduction to Computational Materials Science from ab initio to Montecarlo methods", Springer- Verlag, 1999.
2. Richard Catlow and Eugene Kotomin, "Computational Materials Science", IOS Press, 2003.
3. Rabbe D, "Computational materials Science: The Simulation of Materials Microstructure and Properties", Wiley-VCH , 1998.
4. Frenkel D and Smith B, "Understanding molecular simulation from algorithm to applications", Kluwer, Academic press, 1999.
5. Meyer M and Pontikis V, "Computer Simulation in Material Science: Inter atomic potentials, simulation techniques and applications", Kluwer, Academic press, 2002.

080025 QUANTUM MECHANICS

3 0 0 3

THE PHYSICAL BASIS OF QUANTUM MECHANICS: Experimental background – the uncertainty principle – wave packets. Schroedinger wave equation, time dependent and time independent equations, interpretation of the wave function and its normalisation, probability current density, expectation values of dynamical variables, operators corresponding to dynamical variables and their postulates – eigen functions and eigen values of operators. (8)

VECTOR SPACES AND LINEAR OPERATORS: Representation of operators by matrix-adjoint of an operator – Hermitian operator, unitary operator, similarity transformation, Dirac's Bra and Ket notation. Heisenberg's representation of equation of motion. Matrix theory of Harmonic Oscillator. (7)

HYDROGEN ATOM: Schrodinger equation for Hydrogen like atoms and its solution (rigorous derivation is not included). Discussions of energy eigen values, the hydrogen orbitals and quantum numbers. (5)

ANGULAR MOMENTUM: Orbital angular momentum, spin angular momentum operators and their properties with eigen values and eigen functions. (5)

APPROXIMATION METHODS: Perturbation method – time independent perturbation of non-degenerate and degenerate cases. First order correction, applications. Stark effect and Zeeman effect of Hydrogen atom – harmonic oscillator, helium atom. (7)

VARIATION METHOD: Principles of the variation method for ground state with proof. Application of variation method to He atom. Other simple examples. (4)

TIME DEPENDENT PERTURBATION THEORY: First order correction – interaction between electromagnetic wave and atoms – transition probabilities – Einstein's coefficients – selection rules for harmonic oscillator and hydrogen atom (rigorous derivation not included). (6)

Total 42

REFERENCES:

1. Schiff L I, "Quantum Mechanics", McGraw Hill Book Co.,1975.
2. Ghatak and Lokanathan, "Quantum Mechanics", The MacMillan Co., of India Ltd 1975.
3. Kakani and Chandalia, "Quantum Mechanics", Sultan Chand and Sons, 1980.
4. Coulson ELBS and Oxford University Press, "Valence", 1969.
5. John C Slater, "Quantum Theory of Molecules and Solids" (Vol.I), McGraw Hill Book Co., 1965.
6. Rajput Pragati Prakashan B S, "Advanced Quantum Mechanics", 1990.
7. Amit Goswami, "Quantum Mechanics", WCB Publishers, 1992.

08O026 ELECTRO OPTIC MATERIALS

3 0 0 3

BASICS OF LASER: Laser beam characteristics, modes, noise, types of solid lasers (brief). (5)

FUNDAMENTALS OF CRYSTALLOGRAPHY: Symmetry operations and symmetry elements, point groups, tensor properties, dielectric description of a crystal, crystal structure of KDP, BaTiO₃ and LiNbO₃ (6)

PROPAGATION OF ELECTROMAGNETIC WAVES: Anisotropic media - index ellipsoid, propagation in uniaxial crystals, Birefringence, wave plates and compensators, optical activity . (5)

MATERIALS SELECTION FOR ELECTRO-OPTIC AND ACOUSTO-OPTIC DEVICES: Growth of single crystals - Czochralski, Bridgmann and Zone refining techniques. (4)

ELECTRO-OPTIC EFFECT: E-O effect in KDP E-O retardation, E-O modulation - longitudinal and transverse E-O effect in cubic crystals, E-O Q- switching (Experimental) Beam deflectors. (6)

ACOUSTO-OPTIC AND ELASTO-OPTIC EFFECTS: Materials and devices based on these effects - modulators. (4)

NON LINEAR PHENOMENA: SHG, mode locking and frequency mixing - materials and devices. (5)

NON LINEAR OPTICAL MATERIALS AND DEVICES: Semiconductors - measurement of third order optical non-linearities in semiconductors. Optical switching devices employing optical non-linearities in semiconductors. Glasses - origin of non-linearity in glasses - SHG. (5)

MOLECULAR CRYSTALS: Growth of molecular crystals by temperature difference method. Liquid crystal E-O devices (brief). (2)

Total 42

REFERENCES:

1. Ivan P Kaminov, "An Introduction to Electro-Optic Devices", Academic press, New York, 1974.
2. Yariv A, "Quantum Electronics", John Wiley & Sons, 1975.
3. Munn R W (Ed) and Irons C N, "Non Linear Optical Materials", Blackie Academic & Professional, Glassgow, 1993.
4. Kochner W, "Solid State Laser Engineering", Springer-Verlag, New York, 1976.

08O027 ANALYTICAL METHODS IN MATERIALS SCIENCE

3 0 0 3

CRYSTAL STRUCTURE: Lattice directions and planes - Miller indices - Stereographic projection - Wulff net- Measurement of angle between poles - determination of Miller indices of an unknown pole. X-ray diffraction, Bragg's law, direction of diffracted beam. Diffraction under nonideal conditions - Scherrer formula for estimation of particle size. (5)

X-RAY DIFFRACTION METHODS: Laue method, rotating crystal method, powder method, Debye-Scherrer camera. Intensity of diffracted beams, scattering by an electron; scattering by an atom; scattering by a unit cell - structure factor - Structure factor calculations. (7)

SURFACE STUDY: The need for surface study. Surface chemical composition: The extension of bulk techniques to surface studies - Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Quadrapole mass spectrometer. Special surface techniques: Electron spectroscopy for chemical analysis (ESCA), ultraviolet photo electron spectroscopy (UPS), X ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), Electron energy analysers, Laser Raman Spectroscopy, Secondary ion mass spectrometry, mass spectrometer types - Applications. (7)

SURFACE STRUCTURE AND SURFACE STRUCTURE ANALYSIS: Unit meshes of five types of surface nets - diffraction from diperiodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED), Scanning Probe microscope. (7)

ELECTRON BEAM TECHNIQUES: Transmission electron Microscopy (TEM), Scanning Transmission Electron Microscopy (STEM). Ion Beam Techniques: Rutherford Backscattering Spectrometry (RBS), Field Ion Microscopy (FIM). (7)

ADVANCED MICROSCOPIC TECHNIQUES: Scanning Tunnelling Microscopy, Constant current and constant height - mode - Instrumentation - Atomic Force Microscopy, Imaging modes, Force sensor, Deflection detection. (4)

THERMAL ANALYTICAL TECHNIQUES: Principles of differential thermal analysis, differential scanning calorimetry and thermogravimetric analysis - Instrumentation - determination of transition temperature, heats of transition of plastics, metals and alloys and other materials. (5)

Total 42

REFERENCES:

1. Cullity Addison B D, "Elements of X-ray Diffraction", Wesley Publishing Co., 1967.
2. Prutton M, "Surface Physics", Clarendon Press Oxford, 1975.
3. Treatise on Materials Science and Technology, Volume 27, "Analytical techniques for thin films", Academic Press, Inc., New York, 1991.
4. Rohert S Shankaland, "Atomic and Nuclear Physics", The Macmillan Co., New York 1960.
5. Bacon G E, "X- ray and Neutron Diffraction", Pergamon Press, 1966.
6. Edward A Colline, Jan Bares and Fred W Billmeyer, "Experiments in Polymer science", Jr Wiley - Interscience, 1973.
8. Rodriguez F, "Principles of Polymer Systems", Tata McGraw Hill Co., 1974.

080028 VACUUM SCIENCE AND DEPOSITION TECHNIQUES

3 0 0 3

ELEMENTS OF HIGH VACUUM SYSTEM: Study of a system to produce high vacuum, pumping speed, conductance of an orifice and tube, losses in pumping speed and determination of pumping speed. (5)

TYPES OF PUMPS: Rotary pump, diffusion pump, ejector pump, turbo molecular pump, roots blower pump, getter ion pump, sputter ion pump, cryosorption pump, cryocondensation pump - working principle, construction, operation - pressure range, limitations and pumping characteristics. (8)

PROBLEMS CONNECTED WITH HIGH VACUUM: Outgassing of materials - real and virtual leaks - methods of leak detection - sealing substance outside and pressure change inside - rate of pressure rise method - halogen leak detector and the helium leak detector. (7)

VACUUM COMPONENTS: Baffles and traps: Some designs of baffles, inline trap, right angle trap, dished trap, re-entrant trap, spherical trap and sorption trap, pumping losses in baffles and traps (qualitative). Vacuum valves: Gate valve, disc valve, flap valve, globe valve, needle valve and diaphragm valve. Some types of backable valves (Apart, Theorres and Nier tange valve). Vacuum seals: Common seals using elastomers, sliding and rotating seals, electrical lead and throughs. (9)

VACUUM MEASUREMENTS: Primary gauges: Viscosity gauge, radiometer types gauge, Mcleod gauge with construction and working principle. **Secondary gauges:** Pirani gauge, thermocouple gauge, thermionic ionization gauge, cold cathode ionisation gauge (Penning gauge) - working principle, construction and operation limits. (7)

ULTRA HIGH VACUUM GAUGES: X-ray limit of ionisation gauges, Baird Albert gauge, Klopfer gauge, Helmer gauge, Lafferty gauge, Red head gauge. (3)

MATERIALS USED IN VACUUM SYSTEM: Metals and their alloys, elastomer, glasses, ceramics, vacuum greases, oils, cements and waxes, drying and sorption agents. (3)

Total 42

REFERENCES:

1. Andrew Guthrie, "Vacuum Technology", John Wiley, 1963.
2. Pipko A, et al., "Fundamentals of Vacuum Techniques", Mir publishers, 1987.
3. Albert E Barrington, "High Vacuum Engineering", Prentice Hall, 1964.
4. Green G L, "Design and Construction of Small Vacuum System", Chapman and Hall Ltd, 1968.

5. Leon I Maissel and Reinard Glang, "Hand Book of Thin Film Technology", McGraw Hill, 1970.
6. Davy J R, "Industrial High Vacuum", Sir Isaac Pitman and Sons, 1963.
7. Dennis N TM and Heppel TA, "Vacuum Systems Design", Chapman and Hall Ltd., 1968.

080029 SEMICONDUCTING MATERIALS AND DEVICES

3 0 0 3

PROPERTIES OF SEMICONDUCTORS: Density of states for a 3 dimensional system and in sub 3 dimensional system – Holes in semiconductors, Band structures of some semiconductors. Modification of band structure by alloying and by hetero structures. Quantum well structures, Intrinsic carrier concentration, Defect levels in semiconductors. (10)

DOPING AND CARRIER TRANSPORT: Doping: Extrinsic carrier density – Heavily doped semiconductors – Modulation doping (MODFET) – Transport: Scattering of electrons – Photon and ionised impurity scattering – Low field and high field transport in Si and GaAs – Transport of holes – Very high field transport: Break down phenomena – Avalanche break down (APD) – Carrier transport by diffusion. (10)

P N JUNCTIONS AND BIPOLAR JUNCTIONS TRANSISTORS: P-N junction under bias: Charge injection and current flow – Minority and majority currents – AC response of the p-n diode – Small signal equivalent circuit of a diode – BJT: minority carrier profiles – current components and current gain – Ebers – Moll model – Operating point and small signal equivalent circuits – BJT's in integrated circuits – Heterojunction BJT's – Microwave transistor – Qualitative operation of the JFET and MOSFET. (12)

OPTO ELECTRONIC DETECTORS AND LASER DIODES: Optical absorption in a semiconductor, Materials for optical detectors, Photo current in a p-n diode, Solar cell, Avalanche photo detector, Photo transistor, Quantum well inter subband detector. Laser diode, the laser structure, the optical cavity, optical absorption, Loss and gain, Laser below and above threshold. Advanced structures, Double hetero structure laser, Quantum well lasers, Quantum wire and quantum dot lasers. (10)

Total 42

REFERENCES:

1. Jasprit Singh, "Semiconductor Optoelectronics Physics and Technology", McGraw Hill Co., 1998.
2. Kevin F Brennan, "The Physics of Semiconductors", Cambridge University Press, 1999.
3. Micheal Shur, "Physics of Semiconductor Devices", Prentice Hall of India, 1999.
4. Sze S M, "Physics of Semiconductor Devices", John Wiley and Sons, 2001.

080030 SENSORS FOR ENGINEERING APPLICATIONS

3 0 0 3

STRAIN AND PRESSURE MEASUREMENT: Resistance strain guage, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferomete, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications. (9)

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders. (8)

LIGHT RADIATION: Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state ,transducers liquid crystal devices. (9)

HEAT AND TEMPERATURE: Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector. (8)

ELECTRONIC SENSORS: Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors. (8)

Total 42

REFERENCES:

1. Poebelin, E O, "Measurement Systems, Application and Design", McGraw Hill, Fifth Edition, 2004
2. Jack P Holman, "Experimental Methods for Engineers", Seventh Edition, McGraw Hill, USA, 2001.
3. Ian R Sinclair, "Sensors and Transducers", Third Edition, Newnes publishers, 2001.
4. Robert G Seippel, "Transducers, Sensors and Detectors", Reston Publishing Company, USA, 1983.

CHEMISTRY

080031 ENERGY STORING DEVICES AND FUEL CELLS

3 0 0 3

BATTERY CHARACTERISTICS: Voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. (5)

PRIMARY BATTERIES: The chemistry, fabrication, performance aspects, packing and rating of zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries, zinc/air and lithium button cells- solid electrolyte cells. (5)

SECONDARY BATTERIES: The chemistry, fabrication and performance aspects and rating of lead acid and valve regulated (sealed) lead acid, nickel-cadmium, nickel-zinc, lithium and lithium ion batteries - Rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, thermal batteries. (6)

BATTERIES FOR ELECTRIC VEHICLES: Metal/air, zinc-bromine, sodium-beta alumina and lithium/iron sulphide batteries. (outline only) .Photogalvanic cells. Battery specifications for cars, heart pacemakers, computer standby supplies etc. (5)

FUEL CELLS: Introduction – relevance, importance and classification of fuel cells. Background theory - thermodynamic aspects of electrochemistry-energy conversion and its efficiency – factors affecting the efficiency, electrode kinetics of electrochemical energy conversion. (6)

TYPES OF FUEL CELLS: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Proton Exchange Membrane fuel cells - basic aspects – working and high temperature operation – recent development in technology. (6)

HYDROGEN AS FUEL: Sources of hydrogen and preparation – clean up and storage – use as fuel in cells. (3)

SOLAR CELLS: Energy conversion devices, photovoltaic and photo electrochemical cells – photo biochemical conversion cell. (3)

ENERGY AND ENVIRONMENT: Future prospects-renewable energy and efficiency of renewable fuels – economy of hydrogen energy – life cycle assessment of fuel cell systems. (3)

Total 42

TEXT BOOKS:

1. Aulice Scibioh M.and Viswanathan B, "Fuel Cells – Principles and Applications', University Press (India), 2006
2. Barbir F "PEM fuel cells: theory and practice" Elsevier, Burlington, MA 2005.
3. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001.
4. Pletcher D and Walsh C,"Industrial Electrochemistry", Blackie Academic and Professional, 1993.

REFERENCES:

1. Christopher M A Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, 2004.
2. Newman J S and Thomas -Alyea K.E. "Electrochemical systems" Third Edition, Wiley, Hoboken, NJ 2004.
3. Hoogers G (Ed), "Fuel cell handbook" CRC, Boca Raton, FL 2003
4. Lindon David, "Handbook of Batteries", McGraw Hill, 2002

08O032 POLYMERS IN ELECTRONICS

3 0 0 3

POLYMERIC MATERIALS: Introduction – Origin, classification, formation of polymers – chain growth and step growth polymerization, copolymerization. Thermoplastics and thermosets. Micro structures in polymers – polymer length, molecular weight, amorphous and crystalline, thermal transitions in plastics. (8)

IC FABRICATION PROCESSES: Starting material processes – Silica purification, ingot growth, wafer generation. Imaging processes – pretreatment, coating, softbaking, exposure, development. Deposition and Growth processes – Oxidation, epitaxy, diffusion, ion implantation, metallization, chemical-vapor deposition. Etching and Masking processes – Undoped silicon dioxide etching, doped silicon dioxide etching, polysilicon etching, silicon nitride etching, Aluminium etching, metal lift-off, polyimide etching, resist implant masking, photomask etching. (10)

PHOTORESISTS: Chemistry and types of photoresists – Synthetic photopolymers – Photochemistry of crosslinking – Wafer processable photoresists – Resist processing – Development of crosslinking resists. (6)

ELECTRONICALLY CONDUCTING POLYMERS: General description – Band theory, insulators, semiconductors, metals, semimetals, poly(sulfur nitride), polyacetylene – Synthesis, structure and morphology. Conductivity doping, theory, uses. Phenylene polymers – poly(para-phenylene), poly(phenylene vinylenes),poly(phenylene sulfide). Polypyrrole and Polythiophene, Polyaniline. Stacked phtalocyanine polymers, polymers with transition metals in the side-group structure. (10)

PRINCIPLES OF OPTICAL LITHOGRAPHY: Introduction – Generalized Photolithographic systems. Optical exposure techniques – contact proximity printing, projection printing. Photoresists and substrates – General properties of photoresists, optical properties of positive photoresists, the wafer substrate, substrate topography, multilayer resist technology. Characterisation of lithographic image. (8)

Total 42

TEXT BOOKS:

1. David J Elliot, "Integrated Circuit Fabrication Technology", McGraw-Hill Book Company, USA, 1982.
2. Norman G Einspruch, "VLSI Electronics Microstructure Science", Volume 1, Academic Press, New York, 1981.

REFERENCES:

1. Harry R Allcock, Frederick W Lampe and James E Mark, "Contemporary Polymer Chemistry", Third Edition, Pearson Prentice Hall, 2005.

2. Arnost Reiser, "Photoreactive Polymers the Science and Technology of Resists", Wiley Interscience, New York, 1989.

08O033 ORGANIC ELECTRONICS

3 0 0 3

INTRODUCTION TO ORGANIC ELECTRONIC MATERIALS: Organic electronic materials – classification. Organic Thin-film transistor – architecture, operating mode, fabrication techniques, Structure - property relationships. Methods of improving performance – structural perfection, device architecture. Electrical and environmental stability – chemical effects on stability. Gate dielectrics on electrical functionality. (12)

ADVANCED MATERIALS FOR ORGANIC ELECTRONICS: Pentacene transistors - performance. Engineered pentacenes – Reversible functionalization – end-substituted derivatives, perfunctionalized pentacenes. Heteropentacenes. Semiconductors based on polythiophene and Indolo[3,2-*b*]carbazole – polydialkylterthiophenes, polydialkylquaterthiophenes, polythiophene nanoparticles, indocarbazole designs. (10)

MANUFACTURE METHODS: Production of substrates for organic electronics - Reel-to-reel Vacuum metallization. Organic vapor phase deposition – production of TFTs, OLED, organic photovoltaics. Micro- and nanofabrication techniques – thermal imaging, printing. Digital lithography for TFT fabrication, solution based printing. (10)

DEVICES, APPLICATIONS AND PRODUCTS: Transistors to Integrated circuits – fabrication and characterization of ICs. Non-rigid display – Roll-up Active-matrix displays design. Active –matrix Light-emitting displays – advantages over LCDs, fabrication process. Large-area detectors and sensors – future prospects. Organic semiconductor-based chemical sensors. (10)

Total 42

TEXT BOOK:

1. Hagen Klauk "Organic Electronics: Materials, Manufacturing, and Applications" Wiley-VCH 2006

08O034 FUNCTIONAL COATINGS BY POLYMER MICRO ENCAPSULATION

3 0 0 3

SUITABILITY OF TEXTILES: Textile reactive sites – cellulose, protein, amide, acrylonitrile, ester, urethane, Linkages – ionic, covalent, co-ordinate, vander Waals' – Absorption and adsorption – Glass transition temperature and properties. (9)

CHEMICALS AND POLYMERS FOR DEPOSITS: Titanium oxide, zinc oxide, carbon black, barium sulphate – polyamine, polystyrene, polyalcohol, polyester, polyurethane – eco parameters, surface tension and surface active compounds. (8)

APPLICATION METHODS: Selection of methods for suitable fabric – deposition and reaction type – resin finishing, silicone finishing, emulsion finishing, enzyme finishing – mechanism of durable finishing – heat setting, chemical and electrochemical theory – colloidal theory, solid solution theory. (9)

EFFECT OF TECHNIQUES: Finishing effect – UV protection, stain repellent, anti static, flame retardant, water repellent/water proof, anti microbial. (8)

QUALITY ASSESSMENT: Assessment for durability, strength, softness, stiffness – hydrophilic and hydrophobic character – Suitable testing methods. (8)

Total 42

TEXT BOOKS:

1. Palmer John, W, "Textile Processing and Finishing Aids' Recent Advance", Mahajan Book Distributors, 1996.
2. Peter R H, "Textile Chemistry – Vol – III", The Physical Chemistry of Dyeing, Elsevier, 1975.

REFERENCES:

1. Perkins W S, "Textile Colouration and Finishing", Carolina Academic Press, UK, 1996,
2. Pradip V Mehta, "An Introduction to Quality Control for the Apparel Industry", ASQC Quality Press, NY, 1992.
3. Chaplin and Bucke, "Enzyme Technology", Cambridge university Press, Cambridge, 1990.

08O035 ANALYTICAL METHODS FOR TEXTILES AND TEXTILE ANCILLARIES

3 0 0 3

MOLECULAR WEIGHT DETERMINATION: Number Average, Weight Average, Viscosity average molecular weights. Methods of determination of molecular weight for original and suitably chemical treated textiles. (8)

QUALITATIVE ANALYSIS: Identification of textile polymers – confirmation of different groups in the textile polymers – cellulose, protein, amide, ester – methods of analysis, Fastness characters of different dyes – Investigation of dyes. (6)

QUANTITATIVE ANALYSIS: Analysis of textile polymers in blends – chemicals for different polymers, methods – Density gradient method, solvent method, X-ray method. (6)

MICROSCOPIC, AND X-RAY STUDY: Projection microscopes, Scanning Electron Microscope, X-ray diffraction- Assessment of alignment, morphology, phases and differences that arise during treatments. (8)

SPECTROSCOPIC STUDIES: UV-VIS, FTIR and NMR spectroscopic studies. (8)

QUALITY STUDY: Efficiency of achievement in quality using various suitable chemical treatments – scouring, mercerising, dyeing, printing and finishing, cleaning by wet and solvent methods – Stain removal. (6)

Total 42

TEXT BOOKS:

1. Venkataraman K, "The Chemistry of synthetic Dyes – Vol. I & II, Academic Press, New York, 1990
2. Willard H H, Meritt L L, Dean J A and Settle F A, "Instrumental Methods of Analysis" CBS Publishers and Distributors, New Delhi, 1986.
3. Shenai V A, "Evaluation of Textile Chemicals" Sevak Publications, Mumbai, 1980.

REFERENCES:

1. Skoog D A, Holler F J and Nieman TA, "Principles of Instrumental Analysis", Harcourt Barace College Publishing, FI, 1998.
2. Mukhopadhyay S K, "Advances in Fiber Science", The Textile Institute, UK, 1992.
3. McLaren K, "The Colour Science of Dyes and Pigments", Adam – Hilger, Bristol, UK, 1983.
4. ISI Hand book of Textile Testing, Indian Standards Institution, New Delhi, 1982.

08O036 POLYMERS AND COMPOSITES

3 0 0 3

OVERVIEW: Introduction – Definitions and classification – Matrix at reinforcements – Factors determining properties – benefits of composites. (5)

REINFORCEMENTS AND REINFORCEMENT–MATRIX INTERFACE: Natural, synthetic organic and inorganic fibres – particulate and whisker reinforcements – reinforcement matrix interface. Production, chemistry and properties of glass fibre, asbestos, boron, high silica and quartz fibers. (6)

MATRIX MATERIALS: Manufacturing, chemistry, properties, curing and suitable reinforcing materials for polyester resins, epoxy resins, phenolic and silicones. High temperature resistant polymers. (5)

PROCESSING METHODS: Hand lay-up techniques: Simple and complex, spray-up, wet lay-up low compression molding, moldless lay-ups. Structural laminate bag molding, reinforced molding compounds, prepregs, filament winding. (6)

TESTING OF COMPOSITES: Tension, flexure, interlaminar shear, compression with sandwich beam tests. (3)

NON-DESTRUCTIVE TESTS: Ultrasonic inspection, radiography, vibration and thermal methods, acoustic emission. (3)

POLYMER NANOCOMPOSITES: Classification, nanosized additives, advantages. Clay containing polymeric nanocomposites, polyolefine nanocomposites, polymer silicate nanocomposite via melt – Applications of nanocomposites. (6)

APPLICATION OF POLYMER COMPOSITES: Polymer-matrix composites with continuous and discontinuous fillers application in electrical, electromagnetic, thermoelectric, dielectric, optical applications. Polymer composite for biomedical and vibration damping. (8)

Total 42

TEXT BOOKS:

1. Deborah Chung D L, "Composite Materials: Science and Applications", Springer International, USA, 2004.
2. Matthews F L and Rawlings R D, "Composite Materials: Engineering and Science", Woodhead Publishers, England, 1999.

REFERENCES:

1. Parag Diwan and Ashish Bharadwaj, "Nano Composites", Pentagon Press, India, 2006.
2. George Lubin, "Handbook of Fiberglass and Advanced Plastics Composites", Van Nostrand Reinhold Company, New York, 1969.

08O037 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

THERMODYNAMICS OF AQUEOUS CORROSION: Electrode processes – electrode potential, free energy, emf series, potential measurements, computation and construction of Pourbaix diagrams of Fe, Al, practical use of E-pH diagrams. Chemical Vs electrochemical mechanisms of corrosion reactions, corrosion rate expressions. (7)

KINETICS OF AQUEOUS CORROSION: Corrosion current density and corrosion rate, exchange current density, polarization - activation control, Tafel equation, concentration polarisation, mixed potential theory, combined polarization. Passivity- potentiostatic polarization curves, factors affecting passivity, mechanism of action of passivators. (7)

FACTORS AFFECTING AQUEOUS CORROSION: Effect of environmental variable - effect of pH, oxidation potential, temperature, velocity/fluid flow rate, concentration, biological effects. Effect of metallurgical variables - metals and their surfaces, alloys and their

surfaces, effect of alloying on corrosion resistance, effect of heat treatment. (5)

FORMS OF CORROSION: General corrosion - atmospheric corrosion, galvanic corrosion, general biological corrosion. Localised corrosion - filiform corrosion, crevice corrosion, pitting corrosion, localized biological corrosion. Metallurgically influenced corrosion - inter granular corrosion, de-alloying. Mechanically assisted corrosion - erosion corrosion, fretting corrosion, corrosion fatigue. Environmentally induced cracking – mechanisms of stress corrosion cracking and hydrogen embrittlement. (8)

PREVENTION AND CONTROL OF CORROSION: Corrosion control by design. Selection of corrosion resistant materials – alloying, stainless steel and brass. Oxidation resistant materials, control of high temperature oxidation. Cathodic and anodic protection methods. Use of inhibitors-types, applications. Corrosion in cold water pipes - Langalier saturation index. (6)

CORROSION MONITORING: Introduction - On-stream monitoring – Electrical resistance, linear polarization, hydrogen test probe, ultrasonic testing, radiography and corrosion coupons. Off-stream monitoring equipments – Acoustic emission testing, eddy current inspection, liquid penetration inspection. (5)

CORROSION TESTING: Purpose and classification. Dimensional charge - Ultrasonic thickness measurements, eddy current, microscopic examination. Weight charge – Specimen preparation, test conditions and evaluation of results for overall corrosion, SCC, IGC. Electrochemical techniques – Polarization curves, Tafel extrapolation, linear polarization, AC impedance methods (EIS). (4)

Total 42

TEXT BOOKS:

1. Kenneth R Trethewey and John Chamberlain, "Corrosion – For science and engineering", Second edition, Longman Inc., 1996.
2. Rajnarayan, "Metallic corrosion and prevention", Oxford Publications, 1988.
3. Mars G Fontana, "Corrosion Engineering", Third Edition, Mc Graw Hill Inc., 1987.
4. Herbert H Uhlig and Winston Revie R, "Corrosion and corrosion control – An introduction to corrosion science and Engineering", Third Edition, John Wiley and Sons, 1985.

REFERENCES:

1. ASM hand book – Vol 13: Corrosion, ASM International, 2001.
2. Denny A. Jones, "Principles and Prevention of Corrosion", Second Edition, Prentice Hall Inc., 1996.
3. Philip A Schweitzer, "Corrosion and Corrosion Protection Handbook", USA, 1983.

08O038 CHEMISTRY OF NANOMATERIALS

3 0 0 3

SYNTHESIS OF NANOPARTICLES: Introduction – hydrolysis-oxidation- thermolysis - metathesis-solvothermal methods. sonochemistry; nanometals-powers of metallic nano particles-metallic colloids & alloys -polymer metal composites-metallic oxides-rare earth oxides-mesoporous materials-mixed oxides. sono electro chemistry-nanocrystalline materials. micro wave heating-micro wave synthesis of nano metallic particles. (10)

NLO PROPERTIES OF ORGANIC MATERIALS: Basic concepts-Relationship between molecular structure and NLO properties - Materials design-organic crystals-Poled polymers, self assembled monolayer-Third order NLO materials –Chromophores for optical limiting (8)

NANO POROUS SILICON AND ITS APPLICATIONS: Introduction – Preparation and Characterization of porous silicon substrates – Surface chemistry of porous silicon surfaces – Chemical Applications Based on porous silicon – Bioactive porous silicon.

NANOCATALYSIS: Introduction – Chemical Reaction on point Defects of Oxide surfaces – Chemical Reactions and catalytic Processes on free and supported clusters. (8)

NANOPOROUS MATERIALS: Introduction – Stability of open-Framework Materials – Aluminosilicate Zeolites – Open-framework Metal Phosphates – Aluminum Phosphates – Phosphates of Gallium and Indium – Tin(II)Phosphates and Antimony (III)phosphates – Transition Metal Phosphates – Molybdenum and Vanadium phosphates – Iron phosphates (8)

NANOPARTICLE AND NANOSTRUCTURED MATERIALS: Preparation of Nanoparticle-metal particles: Thermal decomposition of metal carbonyls, semiconductors, Zeolites, inverse micelles, Gels, phosphates and polymers. Ceramic nano particles - sol-gel-Aerosols and Xerogels, precipitation and digestion. Physical and Chemical properties : Metallic behavior – magnetic behavior – Binding energies and melting points –optical and electronic properties –NLO properties –metals and semiconductors. (8)

Total 42

TEXT BOOK:

1. Rao C N R, Muller A and Cheetham A K, "The Chemistry of Nano materials: Synthesis, Properties and Applications", Vol. 1 & 2, Wiley-VCH, 2004.

REFERENCE:

1. Interrante L V and Hampden-Smith M J, "Chemistry of Advanced Materials", Wiley -VCH, 1988.

08O039 POLYMER CHEMISTRY AND POLYMER PROCESSING

3 0 0 3

POLYMERIC MATERIALS: Introduction – Origin, classification, formation of polymers – chain growth and step growth polymerization, copolymerization. Thermoplastics and thermosets. Micro structures in polymers – polymer length, molecular weight, amorphous and crystalline, thermal transitions in plastics. Physical basis of polymer processing – Liquids and viscosity, viscosity and polymer processing, shear stress in polymer system, non-newtonian flow, melt flow index. (10)

MIXING: Polymers and additives – Modifying and protective additives. Physical form of polymer mixes – Types of mixing – Machines for mixing – Twin drum tumbler, ribbon blender high speed mixer, ball mill, two roll mill, banbury mixer. (5)

INJECTION AND EXTRUSION MOULDING: Injection moulding – principle, equipment, material and product considerations, operations and control, special injection molding processes. Extrusion molding – principle, features of single screw extruder, flow mechanism, twin screw extruder, extruder and die characteristics. (7)

BLOW MOLDING AND THERMOFORMING: Principle – extrusion blow molding, injection blow molding, molds and dies, operation and control for blow molding. Thermoforming: Principle, equipment and product considerations, vacuum forming. (6)

COMPRESSION AND TRANSFER MOLDING PROCESS: Principle, thermosetting compounds, compression molding and transfer moulding, reaction injection molding cold forming, sintering and ram extrusion. (5)

CASTING AND FOAMING PROCESS: Casting process – equipment, product considerations, operation and control. Foaming process: Process to create foams in resins, processes to shape and solidify foams, foam insulation. (5)

FIBER REINFORCED PLASTICS: Materials, hand lay-up process, sheet moulding compound (SMC), dough moulding compound, process variants, mechanical strength of fiber reinforce plastics. (4)

Total 42

TEXT BOOKS:

1. Brent Strong A, "Plastics: Materials and processing", Prentice-Hall, New Jersey, 2000.
2. Morton-Jones D.H, "Polymer Processing", Chapman and Hall, New York, 1989.

REFERENCES:

1. Brydson J A, "Plastic Materials", Butterworths, London.
2. Deborah D L Chung, "Composite Materials: Science and Applications", Springer International, USA, 2004.
- 3.

080040 ELECTROANALYTICAL METHODS

3 0 0 3

FUNDAMENTAL CONCEPTS: Electroanalysis, faradaic processes, mass-transport-controlled reactions, potential-step experiment, potential-sweep experiments, rate of electron transfer, activated complex theory, electrical double layer, electrocapillary effect. (8)

ELECTRODE REACTIONS AND INTERFACIAL PROPERTIES: Cyclic voltammetry, reversible, irreversible and quasi-reversible systems, study of reaction mechanisms, adsorption processes, quantitative applications. Electrochemiluminescence. Scanning probe microscopy. Impedance spectroscopy. (10)

CONTROLLED-POTENTIAL TECHNIQUES: Chronoamperometry, polarography, pulse voltammetry, normal-pulse voltammetry, differential-pulse voltammetry, square-wave voltammetry, staircase voltammetry, ac voltammetry. Stripping analysis. (10)

EXPERIMENTAL TECHNIQUES: Construction of cells and instrumentation. Working electrodes and their types. Solvents and supporting electrolytes. (4)

POTENTIOMETRY: Principles of potentiometric measurements, Ion-selective electrodes - glass electrodes, pH electrodes, glass electrodes, liquid membrane electrodes, ion exchanger electrodes, neutral carrier electrodes and solid-state electrodes. (10)

Total 42

REFERENCES:

1. Joseph Wang, "Analytical Electrochemistry", Third edition, Wiley Interscience, 2006.
2. Jeffery G H, Bassett J, Mendham J and Denney R C, "Vogel's Text book of Quantitative Chemical Analysis", ELBS, Fifth Edition, Longman, Singapore Publishers, Singapore, 1996.

080041 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

3 0 0 3

SEPARATION TECHNIQUES: Chromatographic methods - principles, classification – Column chromatography, Liquid chromatography, Paper chromatography, HPLC, Thin layer chromatography, Ion-exchange chromatography, Gas chromatography, GC-Mass chromatography. Supercritical fluid chromatography; Capillary electrophoresis – principles, instrumentation and applications. (8)

THERMAL METHODS OF ANALYSIS: Thermal analytical techniques – TGA, DTA, DSC – principles, instrumentation and applications. (5)

SPECTRAL METHODS: Atomic absorption spectroscopy, Atomic emission spectroscopy, ICP-AES spectroscopy - principles, instrumentation and applications. Flame emission spectroscopy – Flame spectrophotometers, quantitative analysis by flame emission spectroscopy. Light scattering methods – nephelometry, turbidometry, Raman scattering – principles and applications. (10)

UV-VIS SPECTROSCOPY: Basics – types of transitions – Instrumentation – double beam UV-VIS spectrophotometer – Factors influencing λ_{max} – Woodward fieser rules –applications. (5)

IR SPECTROSCOPY: Basics - theory – Instrumentation – sample handling – working of double beam IR spectrophotometer – modes of vibrations – selection rules – factors influencing vibrational frequencies – interpretation of spectra – Finger print region – PQR branches – characteristic group frequencies – applications to organic and inorganic compounds – problems. Raman Spectroscopy: Basics – Stokes and antistokes lines – comparison of IR & Raman – mutual exclusion principle – applications. (6)

MASS SPECTROMETRY: Principles – Instrumentation – double focusing mass spectrometer – molecular ions – metastable ions – fragmentation pattern – McLafferty rearrangement – Retro diels alder reaction – determination of molecular weight – nitrogen rule – fragmentation in organic compounds. Mossbauer spectroscopy: Mossbauer nuclei – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine interactions – applications. (8)

Total 42

TEXT BOOKS:

1. Banwell C N and McCash E M, "Fundamentals of molecular spectroscopy", Fourth Edition, Tata McGraw Hill, New Delhi, 1995.
2. Kemp W, "Organic Spectroscopy", Third Edition, ELBS, McMillan, London, 1991.
3. Williams D H and Fleming I, "Spectroscopic Methods in Organic Chemistry", Fourth Edition, McGraw Hill, New York, 1989.

REFERENCES:

1. Pavia D L, Lampman G M and Kriz G S, "Introduction to Spectroscopy", Third Edition, Brooks/Cole Pub, Singapore, 2001.
2. Drago R, "Physical Methods for Chemists", Saunders, Philadelphia, 1992.
3. Pasto D, Johnson C and M.Miller, "Experiments and Techniques in Organic Chemistry", Prentice- Hall Inc., New Jersey, 1992.
4. Silverstein R M, Bassler G C and Morrill T C, "Spectrometric Identification of Organic Compounds", John Wiley, New York, 1991.

080042 ADVANCED REACTION MECHANISM

3 0 0 3

ADDITION REACTIONS: Reactive intermediates – formation and stability of carbonium ions, carbanions, carbenes and carbenoids, nitrenes, radicals and arynes. Addition to carbon-carbon and carbon – hetero multiple bonds –electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds- orientation and reactivity, addition to conjugated systems and orientation – addition to α,β unsaturated carbonyl groups. (8)

SUBSTITUTION REACTIONS: Aliphatic nucleophilic substitutions – SN1, SN2 and SNi mechanisms- effects of substrate, attacking nucleophile, leaving group and solvent- stereochemistry of nucleophilic substitution reactions- substitutions at carbonyl, bridgehead, vinylic and allylic carbons- neighbouring group participation, norbornyl cation and other non-classical carbocations, ambident nucleophiles – O versus C alkylation. aromatic nucleophilic substitutions - mechanisms effects of substrate, structure, leaving group and attacking nucleophile. – various methods of benzyne generation and reactions of benzyne, reactions of aryl diazonium salts. Vicarious nucleophilic substitution (VNS), Chichibabin and Schiermann reactions - Aromatic electrophilic substitution reactions and mechanisms. (10)

ELIMINATION REACTIONS: E1, E2 and E1cB mechanisms – stereochemistry of E2 elimination – competition between elimination and substitution reactions – orientation effects in elimination reactions – effects of substrate structures, attacking base, leaving group and medium on E1 and E2 reactions – pyrolytic eliminations – Bredt's rule. (8)

REARRANGEMENTS: General mechanistic considerations, nature of migration, migratory aptitude - nucleophilic, electrophilic and free radical rearrangements – Wagner – Meerwein, McLafferty, Demjanov, Benzil-benzilic acid, Favorskii, Fritsch-Buttenberg-Wiechell, Neber, Hofmann, Curtius, Beckmann, Schmidt, Lossen, Wolff, Baeyer – Villiger, Stevens, Wittig, Chapman, Wallach, Orton, Bamberger, Pummerer and Von Richter rearrangements. (8)

REAGENTS IN ORGANIC SYNTHESIS: Diborane, lithium aluminium hydride, sodium borohydride, selenium dioxide, osmium tetroxide, phenyl isothiocyanate, NBS, dicyclohexylcarbodiimide(DCC), lead tetraacetate, pyridinium chlorochromate(PCC), Swern oxidation, p-toluenesulphonyl chloride, trifluoroacetic acid, lithium diisopropylamide (LDA), 1,3-dithiane (reactive umpolung), crown ethers, trimethyl silyl iodide, dichlorodicyanobenzoquinone (DDQ), Gilman's reagent, lithium dimethylcuprate, tri-n-butyltin hydride, di-tert-butoxy dicarbonate, dihydropyran, phase transfer catalysts, Wilkinson's catalysts, Peterson's synthesis, Merrifield resin and diethylaluminium cyanide. (8)

Total 42

TEXT BOOKS:

1. Finar I L, "Organic Chemistry", Vol. II, Fifth Edition, ELBS Longmann Group Ltd. London, 2001.
2. Francis A Carey and Richard J Sundberg, "Advanced Organic Chemistry", Part A and Part B, Third Edition, Plenum press, New York, 1993.
3. Lowry T H and Richardson K S, "Mechanism and theory in Organic Chemistry", Second Edition, Harper and Row Publishers, 1981.

REFERENCES:

1. Kalsi P S, "Organic reactions and their mechanisms", New Age International Publishers, New Delhi, 2006.
2. Jerry March, "Advanced Organic Chemistry", Fourth Edition, Wiley-Intersciences, New York, 2003.
3. Francis A Carey, "Organic Chemistry", Fifth Edition, Tata McGraw Hill, New Delhi, 2003.

4. Mackie and Smith, "Organic Synthesis", Second Edition, Longmann Group Ltd, London, 1990.

08O043 CHEMICAL SENSORS AND BIOSENSORS

3 0 0 3

BIOSENSORS: Introduction – amperometric enzyme electrodes-characteristics- enzyme activity determinations – biosensors for enzyme immunoassay – Potentiometric enzyme electrodes – electrode characteristics and performance –pH glass and ion-selective electrodes – solid-state pH and redox electrodes –gas electrodes. (7)

IMMUNO BIOSENSORS: Potentiometric immunobiosensors – immobilization techniques – analytical applications. Principle and measurements of enzyme thermistor devices. Transducer – experimental techniques – types of biological element: immobilized enzymes – immobilized cells – determination of enzyme activities in solution (7)

CHEMICALLY MEDIATED FIBEROPTIC BIOSENSORS: Introduction – sensing chemistry and materials –sensing techniques – transducer types. Transducer-based fiber optic biosensors – Optical biosensors based on competitive binding (6)

REDOX HYDRO-GEL BASED ELECTROCHEMICAL BIOSENSORS: Electron conducting redox polymer in biosensors –enzyme electrodes – specific sensor examples. Hybridization at oligonucleotide sensitive electrodes: function of oligonucleotide sensitive electrodes – hybridization efficiency and sensitivity – probe oligonucleotide structure and dynamics – hybridization conditions – hybridization kinetics. (8)

FLUOROPHORE AND CHROMOPHORES BASED FIBEROPTIC BIOSENSORS: Enzyme based nonmediated fiberoptic biosensors – chromophores and fluorophore detection. Bioluminescence and chemiluminescence based fiberoptic sensors – bioluminescence and chemiluminescent reactions – analytical potential of luminescent reactions – applications (7)

DETERMINATION OF METAL IONS BY FLUORESCENCE ANISOTROPY: Theory of anisotropy based determination of metal ions – fluorescent aryl sulfonamides for zinc determination- removal of zinc from carbonic anhydrase – determination of zinc using reagent approach – determination of copper and other ions by using reagentless approach. (7)

Total 42

REFERENCES:

1. Copper J M and Cass E G A, "Biosensors ", Second Edition, Oxford University Press, 2004.
2. Blum L J and Coulet P R, "Biosensor Principles and Applications", Marcel Dekker Inc., 1991.

08O044 COMPUTATIONAL PHYSICAL CHEMISTRY

3 0 0 3

REVIEW OF QUANTUM CHEMISTRY: Planck's quantum theory, wave-particle duality – uncertainty principle, operators and commutation relations – postulates of quantum mechanics – Schrödinger equation: free particle, particle in a box – degeneracy, harmonic oscillator, rigid rotor and the hydrogen atom. Angular momentum, including spins, coupling of angular momentum including spin-orbit coupling. (8)

FOUNDATIONS OF MOLECULAR ORBITAL THEORY: The variation method – perturbation theory – application to helium atom – antisymmetry and exclusion principle – Slater determinantal wave equation – Born-Oppenheimer approximation – Hydrogen molecule ion – LCAO-MO and VB treatments of the hydrogen molecule – Electron density, forces and their role in chemical binding. Hybridization and valence MO'S of H₂O, NH₃ and CH₄ – Huckel pi-electron theory and its applications to ethylene, butadiene and benzene – idea of self-consistent fields. (8)

GROUP THEORY: The concept of groups – classes – Abelian group – cyclic group – multiplication table. Symmetry elements and symmetry operations. Point group classification. Matrix representations and symmetry operations. Reducible and irreducible representation
Character tables for point groups : Orthogonality theorem. Properties of irreducible representation construction of character tables for point groups. The relationship between reducible and irreducible representation. Representations and vibrational modes in H₂O, NH₃ and BF₃ molecules. (8)

AB INITIO THEORY AND CHEMICAL APPLICATIONS: Hartree theory – Hartree-Fock SCF method – electron correlation – Moller-Plesset theory – Basis set – functional forms – contracted Gaussians – single, multiple, split-valence – polarization function – diffuse functions – computation procedure for the solution of SCF equations – energy gradient – molecular geometry – conformation searching – solvent effect – molecular interactions. (7)

DENSITY FUNCTIONAL THEORY: Thomas-Fermi model – The Hohenberg-Kohn theorem – The Kohn-Sham equations – exchange-correlation potentials – chemical potential – Electronegativity – Global hardness and softness – local hardness and softness – Fukui functions – Sanderson's electronegativity equalization principle – Pearson's hard and soft acids and bases principle – the maximum hardness principle. (7)

COMPUTER APPLICATIONS: Coordinate specification – Z-matrix – Cartesian coordinates – Introduction to structure drawing – Hands on use of software packages – Gaussian; Gamess, Molden. (4)

Total 42

TEXT BOOKS:

1. Atkins P W and Friedman R S, "Molecular Quantum Mechanics", Oxford University Press, Newyork, 2001.
2. Helgaker T, Jorgensen and Olsen J, "Molecular Electronic Structure Theory", John Wiley, Newyork, 2000.
3. Ira N Levine, "Quantum Chemistry" Prentice Hall, 1991.
4. Gopinathan M S and Ramakrishnan V, "Group theory in Chemistry " Vishal Publishers, New Delhi, 1988.

REFERENCES:

1. Cramer C J, "Essentials of Computation Chemistry", Wiley, Chichester, 2002.
2. Leach A R, "Molecular Modelling – Principles and Applications", Prentice Hall, 2001.
3. Robert G Parr and Weitao yang, "Density Functional Theory of Atoms and Molecules", Oxford University press, Newyork, 1989.
4. Szabo A and Ostlund N S, "Modern Quantum Chemistry", McGraw Hill, Newyork, 1989.
5. Warren J Hehre, Leo Radom, Paulv R.Schleyer and John A Pople, "Ab initio Molecular Orbital Theory", John Wiley, Newyork, 1986.
6. Davidson G, 'Introductory group theory for chemistry" Applied Science Publications London 1971.

80045 MOLECULAR SPECTROSCOPY**3 0 0 3**

UV-VIS SPECTROSCOPY: Basics – types of transitions – Instrumentation – double beam UV-VIS spectrophotometer – Factors influencing λ_{\max} – Woodward fieser rules –applications. (6)

IR SPECTROSCOPY: Basics - theory – Instrumentation – sample handling – working of double beam IR spectrophotometer – modes of vibrations – selection rules – factors influencing vibrational frequencies – interpretation of spectra – Finger print region – PQR branches – characteristic group frequencies – applications to organic and inorganic compounds – problems.
Raman Spectroscopy: Basics – Stokes and antistokes lines – comparison of IR & Raman – mutual exclusion principle – applications. (10)

MASS SPECTROMETRY: Principles – Instrumentation – double focusing mass spectrometer – molecular ions – metastable ions – fragmentation pattern – McLafferty rearrangement – Retro diels alder reaction – determination of molecular weight – nitrogen rule – fragmentation in organic compounds.
Mossbauer spectroscopy: Mossbauer nuclei – Doppler effect – isomer shift – quadropole splitting – magnetic hyperfine interactions – applications. (12)

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: Proton magnetic resonance – theory – relaxation processes – chemical shift – factors affecting chemical shift – spin-spin coupling – coupling constants – first order splitting patterns and second order effects on spectrum – AMX, ABX and ABC systems – Nuclear overhausear effect – Double resonance – ¹³C NMR spectra – theory – chemical shifts and correlations. (10)

ELECTRON SPIN RESONANCE SPECTROSCOPY: Principle – factors affecting the intensity – hyperfine splitting – g values and their significance – application to simple systems. (4)

Total 42**TEXT BOOKS:**

1. Banwell C N and McCash E M, "Fundamentals of molecular spectroscopy", Fourth Edition, Tata McGraw Hill, New Delhi, 1995.
2. Kemp W, "Organic Spectroscopy", Third Edition, ELBS, McMillan, London, 1991.

REFERENCES

1. Pavia D L, Lampman G M and Kriz G S, "Introduction to Spectroscopy", Third Edition. Brooks/Cole Pub, Singapore, 2001.
2. Pasto D, Johnson C and Miller M, "Experiments and techniques in Organic Chemistry", Prentice- Hall Inc., New Jersey, 1992.
3. Drago R, "Physical Methods for Chemists", Saunders, Philadelphia, 1992.
4. Silverstein R M, Bassler G C and Morrill T C, "Spectrometric Identification of Organic Compounds", John Wiley, New York, 1991.
5. Williams D H and Fleming I, "Spectroscopic Methods in Organic Chemistry", Fourth Edition, McGraw Hill, New York, 1989.

HUMANITIES**080046 PRINCIPLES OF MANAGEMENT****3 0 0 3**

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Engineers and Organizational Environment – Social, Economic, Technological and Political. Social Responsibility of Engineers. (5)

MANAGEMENT CONCEPTS: MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM. (5)

BUSINESS PROCESS REENGINEERING: Need for BPR, Various phases of BPR, Production and Productivity – Factors Influencing Productivity. (4)

ORGANIZATIONAL BEHAVIOUR: Significance of OB, Role of leadership, Personality and Motivation. Attitudes, Values and Perceptions at work. (5)

INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (5)

MATERIALS MANAGEMENT: Importance and Scope of Materials Management, Purchase Procedure, Inventory Control and Systems for Inventory Control – ROL, EOQ, MRP, ABC Analysis, VED, FSN and Value Analysis. (4)

MARKETING MANAGEMENT: Definition and Approaches to Marketing Management – Marketing Environment. The Marketing Process. Marketing Mix, Advertising, Sales Promotion and Consumer Behaviour. (4)

HUMAN RESOURCE MANAGEMENT: Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development – Case Discussion. (4)

JOB EVALUATION: Meaning and Methods of Job Evaluation. Performance Appraisal – Meaning and Methods of Performance Appraisal. (3)

WELFARE IN INDUSTRY: Working condition, service facilities, legal legislation – Factories Act, 1948 and Workmen's Compensation Act. (3)

Total 42

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" - Tata McGraw Hill, New Delhi, 2004.
2. Mamoria C B, "Personnel Management", Sultan Chand and Sons, New Delhi, 2002.

REFERENCES:

1. John W Newstrom, Keith Davis, "Organizational Behavior", Tata McGraw Hill, New Delhi, 2002.
2. Philip Kotler, "Marketing Management", Pearson Education Asia, New Delhi, 2003.
3. Khanna O P, "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2003.

080047 HUMAN RESOURCE MANAGEMENT

3 0 0 3

NATURE AND SCOPE OF HUMAN RESOURCE MANAGEMENT: Meaning and Definition of HRM, Objectives and Functions of HRM, Models of HRM, HRM in a changing Environment, Role of Globalization in Human Resource Management. (4)

HUMAN RESOURCE PLANNING: Job analysis – Job Specification – Recruitment – Induction – Selection – Placement: Role in HRM, Process, Methods, use of Tests in Selection and Placement. (5)

WAGE AND SALARY ADMINISTRATION: Principles and Techniques of Wage Fixation, Job Evaluation, Incentive Schemes. (4)

PERFORMANCE APPRAISAL: Process, Methods, Factors that distort appraisal, Methods to Improve Performance, Role of Performance in the Performance Management Process, Performance Appraisal Vs. Potential Appraisal. (5)

TRAINING AND DEVELOPMENT: Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives. (4)

MORALE AND MOTIVATION OF EMPLOYEES: Morale-importance of Moral-employee Attitudes and Behaviour and their significance to Employee Productivity. Motivation Methods of Employees, Empowerment – Factors Affecting Empowerment – Process – Benefits. (4)

WORK ENVIRONMENT AND TERMS AND CONDITIONS OF EMPLOYMENT: Fatigue – Safety – Accident Prevention Accident Records – Industrial Relations. (4)

INTERNATIONAL HRM: Model, Variables that outline difference between local and International HRM approaches to IHRM, Linking HRM to International Expansion Strategies. (5)

TRENDS IN HR: HR Outsourcing – HRIS – Management of Turnover and retention – Workforce Relationization – Managing Separation – Trends in Employee Engagement and Retention. (7)

Total 42

TEXT BOOK:

1. Gary Dessler, "Human Resource Management", Prentice Hall of India, New Delhi, 2003.

REFERENCES:

1. Dezenzo A David and Robbins P Robbins, "Human Resource Management", John Wiley and Sons, Inc, MA., 2002.
2. Aswathappa K, "Human Resource and Personnel Management – Text and Cases", Tata McGraw Hill, 2002.
3. Bernardin H and John, "Human Resource Management – An experiential Approach", Tata McGraw Hill, 2004.
4. Cascio H and Wayne, "Managing Human Resources – Productivity, Quality of Work Life and Profits, Tata McGraw Hill, 2004.

080048 INTRODUCTION TO MANAGEMENT

3 0 0 3

INTRODUCTION: An Introduction to Management – The Management Process – Managerial Roles – Managerial Skills – the Science and Art of Management – Becoming a Manager. (4)

THE ENVIRONMENTAL CONTEXT OF MANAGEMENT: The Organization's Environments – The External Environment – The General Environment – The Internal Environment – The Organization's Culture (its importance, determinants and management), Models of Organizational Effectiveness. (4)

THE ETHICAL AND SOCIAL ENVIRONMENT: Ethical Behavior - Social Responsibility and Organizations (Areas, arguments for and against – Including Approaches to Social Responsibility – The Government and Social Responsibility – Evaluating Social Responsibility. (5)

THE GLOBAL ENVIRONMENT: The Nature of International Business – The meaning of International Business – Trends in International Business – The Cultural Environment. (4)

PLANNING AND DECISION MAKING: The Decision Making and Planning Process – Organizational Goals – Organizational Planning – Contingency Planning and Crisis Management – Barriers to Goal Setting and Planning – Overcoming the barriers – Using Goals to Implement Plans. (4)

THE NATURE OF STRATEGIC MANAGEMENT: The Components of Strategy – Types of Strategic Alternatives – Strategy Formulation and Implementation – Using SWOT Analysis to Formulate Strategy – Porter's Generic Strategies – Implementing Porter's Generic Strategies. (4)

BASIC ELEMENTS OF ORGNIZING: Grouping Jobs – Departmentation – The Delegation Process – Decentralization and Centralization – Differences Between Line and Staff. (4)

MANAGING ORGANIZATIONAL CHANGE AND INNOVATION: Steps in the Change Process – Understanding Resistance to Change – Overcoming Resistance to Change – Changing Business Processes – Organization Development – The Innovation Process – Forms of Innovation – The Failure to Innovate – Promoting Innovation in Organizations. (5)

MANAGING HUMAN RESOURCES INORGANIZATIONS: The Strategic Importance of HRM – The Legal Environment of HRM – Human Resource Planning – Recruiting Human Resources – Selecting Human Resources – Training and Development – Performance Appraisal – Performance Feedback. (4)

MANAGING WORK GROUPS AND TEAMS: Types of Groups and Teams – The reality of Virtual Teams – Stages of Group and Team Development Behavioural Norms – Cohesiveness – Formal and Informal Leadership – The Nature of Conflict – Causes of Conflict – Stimulating Conflict – Controlling Conflict – Resolving and Eliminating Conflict. (4)

Total 42

TEXT BOOK:

1. Ricky W Griffin, "Management", Houghton Mifflin, 2002.

REFERENCES:

1. Radha R Sharma, "Change Management – Concepts and Applications", Tata McGraw Hill, New Delhi, 2007.
2. Philip Kotler, "Marketing Management", Pearson Education Asia, New Delhi, 2003.
3. Khanna O P, "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2003.

08O049 ORGANISATIONAL BEHAVIOUR

3 0 0 3

MEANING & IMPORTANCE OF OB: Historical Development & Contributing Disciplines. (2)

PERSONALITY AND EMOTIONS: Its Determinants & Attributes – Values & Attitudes – Components and Functions of Attitudes – Emotional Intelligence. (3)

MOTIVATION: Basic Concepts, Motivation Theories, Problems in Motivation. (2)

VALUES: Attitudes and Job Satisfaction. (2)

GROUP DYNAMICS: Types of Groups, Group Norms and Cohesiveness: Group Roles. (2)

COMMUNICATION: Functions – Fundamentals and Current Issues. (3)

TEAM BASED ORGANIZATION: Need for Teams – Team Building – Effectiveness of Teams. (3)

ORGANIZATIONAL CULTURE: Element, Culture and Performance Merging Organizational, Cultures, Changing and Strengthening Culture. (3)

CONFLICTS AND NEGOTIATION. (3)

LEADERSHIP: Theories of Leadership, Leadership Styles and Effectiveness. (4)

EMPLOYMENT RELATIONSHIP AND CAREER DYNAMICS: The Psychological Contract – Socialization – Organizational Careers – Contingent Workforce. (4)

ORGANIZATIONAL CHANGE: Forces for Change Force - Resistance to change Field - Analysis Model – Organization Development.	(4)
WORK STRESS: Causes and Consequences – Stress coping Strategies.	(4)
CASES	(3)
Total	42

TEXT BOOK:

1. Luthan Fred, "Organizational Behaviour", Mc Graw Hill Inc., New York, 2000.

REFERENCES:

1. Robbins Stephen P, "Organizational Behaviour", Prentice Hall (India) Pvt. Ltd., New Delhi, Ninth Edition, 2000.
2. New Newstorm John W and Davis Keiuth, "Organizational Behaviour – Human Behaviour at Work", Tata Mc Graw Hill Publishing Co., Ltd., New Delhi, 1995.
3. Mcshane Vonglinow, "Organisational Behaviour", Tata Mc Graw Hill, 2001.
4. Kreitner Robert, Kinicki, Angelo, "Organisational Behaviour", Irwin Inc., Illinois, 1997.

08O050 VALUE MANAGEMENT

3 0 0 3

INTRODUCTION: Management Science –Art – Development of Management as a profession – Principles of Scientific Management.	(4)
VALUE BASED MANAGEMENT : Creating Shareholder Value.	(3)
MINTZBERG'S MANAGEMENT ROLES.	(1)
PLANNING: The meaning and purpose of planning – Steps in Planning –Types of Plans.	(4)
MANAGEMENT BY OBJECTIVES.	(2)
POLICIES, PROCEDURES AND METHODS: Nature and type of policies – functional policies.	(2)
DECISION MAKING PROCESS AND FUNDAMENTALS: Types of decisions.	(2)
ORGANIZING: Meaning and structure – Authority and span of control, Delegation and decentralization – Line and Staff relationship.	(4)
STAFFING: Sources of recruitment – Selection Process.	(3)
CO-ORDINATION: Steps to promote coordination.	(1)
DIRECTING: Nature of directing – Leadership, motivation and communication.	(3)
CONTROLLING IN MANAGEMENT: Control Process.	(5)
CHANGE MANAGEMENT: Organizational Change, Perspectives on Organizational Change.	(4)
INNOVATION MANAGEMENT.	(4)
Total	42

TEXT BOOK:

1. Koontz Harold & Wehrich Heinz, "Essentials of Management: An International Perspective", Tata McGraw Hill, 2004.

REFERENCES:

1. Tripathi P C and Reddy R N, "Principles of Management", Tata McGraw Hill, 2006.
2. Rao V S P and Hari Krishna V, "Management: Text and Cases", Excel Books, 2002.
3. Satyaraju Parthasarathy, "Management", Prentice Hall (India) Pvt. Ltd., 2006.

08O051 HUMAN VALUES AND PROFESSIONAL ETHICS

3 0 0 3

MANAGEMENT: Meaning, Definition, Significance, Functions – Planning, Organizing, Staffing, Directing and Controlling, Principles of Management.	(4)
SOCIAL RESPONSIBILITY AND ETHICS: Concept of Social Responsibility, Views of Social Responsibility – Economic Objectives Vs Social Objectives – Business Ethics.	(4)
PROBLEM SOLVING METHODS: SWOT Analysis of a Traditional Engineer – Kaizen Strategy and Values – Kaizen Approach for Problem Solving.– Process Oriented Management Vs Result Oriented Management.	(4)

HUMAN VALUES: Value Crisis in Contemporary Indian Society, Aesthetic Values, Moral and Ethical Values, Spiritual Values, Values in the Work Place. (4)

INTERPERSONAL RELATIONSHIPS: Managing Emotions, Emotional Intelligence, Building Better Interpersonal Relations, Managing the Boss, Dealing with Subordinates – Case Study. (5)

CREATIVITY: Creativity and Problem Solving – Creativity Process – Creative Individuals and their Characteristics – Techniques for Creative Problem Solving. (4)

HUMAN RESOURCE MANAGEMENT: Importance, Objectives, Functions, Job Analysis and Recruitment, Selection and Placement. (4)

HUMAN RESOURCE DEVELOPMENT: Training and Learning, Determining Training Needs and Priorities, Formal Employee Training Methods, Management Development, Methods for Developing Managers, Evaluating Training Effectiveness – Case Study. (5)

LEADERSHIP: Definition, Characteristics of Leadership, Leadership styles, Theories of Leadership – Tannenbaum – Schmidt Leadership Continuum – Managerial Grid Theory. (4)

MOTIVATION: Meaning and Definition – Mechanism of Motivation – Maslow's Need Hierarchy Theory, Mc Gregor's Theory X and Y- Herzberg's Two Factor Theory. (4)

Total 42

TEXT BOOKS:

1. Tripathi A N, "Human values", New Age international Pvt. Ltd., New Delhi, 2002
2. Mamoria C B, "Personnel Management", Sultan Chand and Sons, New Delhi, 2002.

REFERENCES:

1. Bishop, Sue, "Assertiveness Skills Training – A Source Book of Activities", Viva Books Pvt. Ltd., New Delhi, 2002.
2. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management", Tata McGraw Hill, New Delhi, 2004.
3. Jayshree Suresh and Raghavan B S, "Professional Ethics" S. Chand and Company Ltd., New Delhi, 2005.

08O052 MICRO ECONOMIC ENVIRONMENT

3 0 0 3

INTRODUCTION TO MICRO ECONOMICS: Basic problems of an Economy – Business Decisions. (5)

MARKET MECHANISM: Price determination by demand and supply forces – Taxes and Subsidies. (6)

ELASTICITIES OF DEMAND AND SUPPLY: Applications. (4)

THEORY OF CONSUMER BEHAVIOUR: Consumer Surplus – Applications. (4)

THEORY OF PRODUCTION AND COSTS: Short run and long run – Economies of Scale. (4)

MARKET STRUCTURE: Perfect competition, monopoly, oligopoly and monopolistic competition. (6)

INTRODUCTION TO GAME THEORY. (5)

EXTERNALITIES AND PUBLIC GROWTH. (4)

UNCERTAINTY AND RISK. (4)

Total 42

TEXT BOOK:

1. Alee Chrystal K and Richard G Lipsey, "Economics for Business and Management", Oxford University Press, 1997.

REFERENCES:

1. Pindyck R S and Rubin Feld D L., "Micro Economics", Prentice Hall of India, 2002.
2. Francis Cheraneelam, "Business Environment – Text and Cases", Himalaya Publishing House, Mumbai, 2006.

08O053 MARKETING SYSTEMS

3 0 0 3

DEFINITION: Scope – Philosophies of Marketing Management – Goals of Marketing Systems – Marketing Strategy – An overview of the Process. (3)

OPPORTUNITY ANALYSIS: Identifying Attractive Markets – Macro Trend Analysis – The Demographic Environment – Socio Cultural Environment – Economic Environment – Political / Legal Environment – Technological Environment Case Analysis. (3)

INDUSTRY ANALYSIS AND COMPETITIVE ADVANTAGE: Defining Markets and Industry – Industry Analysis Porter's Five Competitive Forces.	(3)
CONSUMER MARKETS AND BUYING BEHAVIOUR: Buying Population – Buying Decision – Buying Participants – Buying Influences – Buying Process – Case Analysis.	(4)
MARKET SEGMENTATION, TARGETING, AND POSITIONING: Marketing Mix – Different Targeting Strategies – The Positioning Process – Case Analysis.	(4)
THE MARKETING INFORMATION SYSTEMS: The Concept of Market – Information System.	(3)
PRODUCT PLANNING AND POLICY: New Product Development – Product Life Cycle – BCG Matrix – Product Branding, Brand Positioning, Packaging and Service.	(3)
PRODUCTMIX STRATEGIES: Branding Strategies – Sustaining Competitive Advantage over the Product Life Cycle.	(3)
PRICING: Setting of Price – Initiating Price Changes – Responding to Price Changes – Discount Structure – Factors Influencing Price Determination – Price Strategies.	(3)
MARKETING CHANNEL AND PHYSICAL DISTRIBUTION: Channel Design – Channel Management – Channel Modification – Retailing – Wholesaling.	(3)
INTRODUCTION TO ADVERTISING, SALES PROMOTION AND PUBLIC RELATIONS: Publicity and Personal Selling.	(3)
DEVELOPING AND MANAGING AN ADVERTISING PROGRAM: Effectiveness of Advertising.	(3)
INDUSTRIAL MARKETING: Characteristics of Industrial Markets – Consumer Markets and Industrial Markets – Buying Behaviour Models.	(4)
	Total 42

TEXT BOOK

1. Philip Kotler and Kevin Keller, "Marketing Management", Prentice Hall of India, Twelfth Edition, 2005.

REFERENCES:

1. Walker, Boyd, Mullins and Lancher, "Marketing Strategy – A Decision Focused Approach", Tata McGraw Hill, 2003.
2. Michael J Etzel, Brucc Walker, William J Stanton and Ajay Pandit, "Marketing – Concepts and Cases", Tata McGraw Hill, 2006.

08O054 ENTREPRENURSHIP

3 0 0 3

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance of Entrepreneurship.	(5)
CREATIVITY AND INNOVATION: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process.	(5)
DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Components of an Effective Business Model – Developing and Writing the Business Plan.	(6)
APPRAISAL OF PROJECTS: Importance of Evaluating Various options – Appraisal Techniques.	(4)
FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Joint Stock Companies and Cooperatives.	(4)
FINANCING THE NEW VENTURE: Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Evaluating Financial Performance.	(4)
THE MARKETING FUNCTION: Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process.	(6)
MANAGING GROWTH OF NEW VENTURES: Challenges of Growth – Strategies for Firm Growth – Internal and External Growth Strategies.	(4)
ETHICAL AND SOCIAL RESPONSIBILITY CHALLENGES FOR ENTREPRENEURS: Ethics, Values and Social Responsibility – Ethics and Business Decisions.	(4)
	Total 42

TEXT BOOK:

1. Robert D Hisrich, Michael P Peters and Dean Shepherd, "Entrepreneurship", Tata McGraw Hill, 2007.

REFERENCES:

1. Marc J Dollinger, "Entrepreneurship – Strategies and Resources", Pearson Education, 2003.
2. Bruee R Barringer and Duane Ireland, "Entrepreneurship – Successfully Launching New Ventures", Pearson – Prentice Hall, 2006.
3. Mary Coulter, "Entrepreneurship in Action", Prentice Hall of India, 2006.

080055 ANALYSIS OF MANUFACTURING AND SERVICE SYSTEMS**3 0 0 3**

CONCEPT OF OPERATIONS MANAGEMENT: Characteristics of Manufacturing Sector and Service Sector – Evolution of Operations Management Discipline – Concepts and Calculations of Productivity – Productivity Improvement Measures. (5)

CONCEPT OF TOTAL QUALITY MANAGEMENT: KAIZEN - Philosophies of Deming, Juran and Crosby – Statistical Process Control – Concept of Acceptance Sampling. (4)

DEMAND FORECASTING: Moving Average – Exponential Smoothing – Trend Projections – Regression and Correlation Analysis. (4)

JOB PRODUCTION: Mass Production – Batch Production – Continuous Processing – Special Projects – Make or Buy Decisions. (4)

LOCATION ANALYSIS: Centres of Gravity Method – Factor Rating Method – Locational Breakeven Analysis Method. (4)

LAYOUT ANALYSIS: Process Layout and Cellular Layout – Line Balancing. (6)

MATERIALS MANAGEMENT: Aggregate Production Planning – Gantt Charts – Sequencing and Scheduling. (5)

METHOD STUDY: Concept – Techniques of Work Study – Method Study – Definition – Procedure for Method Study – Principles of Motion Economy – Selection – Recording – Techniques – Uses of Films – Examine – Develop – Install and Maintain. (6)

WORK MEASUREMENT: Definition – Objectives – Techniques of Work Measurement – Time Study – Procedure – Advantages. (4)

PRODUCTION MANAGEMENT: Types of Production – Characteristics – Application – Standardization – Objectives – PPC – Objectives – Functions – Preplanning – Routing – Scheduling – Dispatching and Controlling. (6)

Total 42**TEXT BOOK:**

1. Buffa E S and Sarin R K, "Modern Production / Operations Management", John Wiley and Sons, Singapore, 2000.

REFERENCES:

1. Lee J Krajewski and Larry P Ritzman, "Operations Management-Strategy and Analysis", Pearson Education, 2005.
2. Chase R B, Aquilano N J and Roberts F R, "Production and Operations Management: (Manufacturing and Services)", Tata McGraw Hill, New Delhi, 1999.
3. Heizer J and Render B, "Production and Operations Management: (Strategies and Tactics)", Prentice Hall New Jersey, 1996.

080056 FINANCIAL AND MANAGEMENT ACCOUNTING**3 0 0 3**

MANAGEMENT ACCOUNTING: Meaning – Nature and Scope – Functions – Limitations – Need – Financial Accounting vs. Management Accounting. (3)

FINANCIAL STATEMENTS: Characteristics – Limitations – Financial Statement Analysis – Ratio Analysis. (5)

FUND FLOW STATEMENT: Meaning and Concept of Flow of Funds – Meaning of a Fund Flow Statement – Differences between Fund Flow Statement and Income Statement – Preparation and Interpretation of Fund Flow Statement. (4)

CASH FLOW STATEMENT: Meaning of a Cash Flow Statement – Classification of Cash Flows – Preparation and Interpretation of Cash Flow Statement. (4)

FINANCIAL MANAGEMENT: An Overview – Nature and Scope – Finance Functions – Goals of Financial Management – Financial Manager's Role – Agency Problems, Agency Cost – Economic Value Added. (5)

SOURCES OF FINANCE: Long Term Finance – Ordinary Shares – Right Issue of Equity Shares – Preference Shares – Debentures – Term Loan – Asset Based Financing – Hire Purchase – Leasing – Venture Capital Financing – Short Term Finance – Trade Credit – Bank Credit – Bill Discounting – Commercial Paper. (5)

TIME VALUE OF MONEY: Concept – Future Value – Present Value – Single Cash Flows – Annuity – Uneven Cash Flows – Multi Period and Continuous – Yield Calculation. (4)

INVESTMENT DECISION: Capital Budgeting Decisions – Evaluation of Capital Budgeting – Discounted and Non Discounted – Cash Flows Methods – Simple Problems. (4)

FINANCING AND DIVIDEND DECISION: Capital Structure – Financial Leverage – Operating Leverage – Only Concepts – Capital Structure Theories – Dividend Theories. (4)

WORKING CAPITAL: Policies for Financing Current Assets. (2)

RECEIVABLES MANAGEMENT, INVENTORY MANAGEMENT AND CASH MANAGEMENT: Basic Concepts Only. (2)

Total 42

TEXT BOOK:

1. Damodaran Aswath, "Corporate Finance-theory and Practice", Tata McGraw-Hill, New Delhi, 2005.

REFERENCES:

1. Ross S A, Westerfield R W and Jordan B D, "Fundamentals of Corporate Finance", Tata McGraw-Hill, New Delhi, 2006.
2. Myers Brealey, "Principles of Corporate Finance", Vikas Publishing House P Ltd, 2005.
3. Pandey IM, "Financial Management", Ninth Edition, Vikas Publishing House P Ltd, 2005.
4. Prasanna Chandra, "Financial Management", Tata McGraw-Hill, New Delhi, 2004.

080057 MANAGERIAL FINANCE

3 0 0 3

THE FINANCE FUNCTION: The Nature of the Firm and Its Goals – Value Maximization as a Goal – Role of Financial Management. (5)

FINANCIAL STATEMENTS: Sample Income Statement – Sample Balance Sheet – Sources and Uses of Funds – Reporting Requirements. (4)

THE TAX ENVIRONMENT: Corporate Income Tax – Personal Income Tax. (4)

DEPRECIATION METHODS: Straight Line – Sum-of-Years'-Digits – Units of Production – Declining Balance Methods – Effect of Depreciation on Taxes Paid – Depreciable Life of an Asset. (4)

THE TIME VALUE OF MONEY: Future Value – Present Value – Present Value of an Annuity. (4)

CAPITAL BUDGETING TECHNIQUES: Significance of Capital Budgeting – Ranking Investment Proposals – Projects with Different Lives – Projects with Different Scale. (4)

FINANCIAL RATIO ANALYSIS: Basic Financial Statements – Basic Types of Financial Ratios – Use of Financial Ratios – Some Limitations of Ratio Analysis. (5)

PORTFOLIO THEORY – DECISION MAKING UNDER UNCERTAINTY: Introduction – Market Equilibrium – Pricing Inefficient Portfolios. (4)

SENSITIVITY ANALYSIS OF RISKY PROJECTS: Monte Carlo Simulation Analysis – Decision Trees. (4)

CAPITAL STRUCTURE AND THE COST OF CAPITAL: Leverage and the Cost of Capital – Theory – Calculating the Component Financing Costs. (4)

Total 42

TEXT BOOK:

1. Fred Weston J and Thomas E Copeland, "Managerial Finance", The Dryden Press, London, 1982.

REFERENCES:

1. Samuels J M, Wilkas F M and Bray Shaw R E, "Financial Management and Decision Making", International Thomson Business Press, 1999.
2. John J Pringle and Robert S Harris, "Essentials of Managerial Finance", SCOH Foresman and Company, London, 1987.
3. Fred Weston J and Eugene F Brigham, "Essentials of Managerial Finance", Holt-Saunders International Editions, New York, 1982.

080058 WORKING CAPITAL MANAGEMENT

3 0 0 3

WORKING CAPITAL POLICY: Importance of Working Capital Management – Risk-Return Tradeoff for Current Asset Investments – Financing Current Assets – The Costs and Risks of Alternative Debt Maturities. (6)

CASH AND MARKETABLE SECURITIES MANAGEMENT: Cash and Marketable Securities Management – Managing Disbursements – Marketable Securities – Cash Management Models. (6)

CASH MANAGEMENT MODELS: Baumol Model – Miller-Orr Model – Beranek Model – A Comparison of the Models.	(6)
INVENTORY MANAGEMENT: Inventory – Generality of Inventory Analysis – The EOQ Model – Extending the EOQ Model.	(6)
CREDIT MANAGEMENT AND POLICY: Credit Standards – Terms of Trade Credit – Evaluating Changes in Credit Policy – Use of Computers in Credit Management.	(6)
THE PAYMENTS PATTERN APPROACH: Corporate Practice – Payments Pattern Approach.	(6)
SHORT-TERM FINANCING: Trade Credit – Short-Term Financing by Commercial Banks – Commercial Paper – Bankers' Acceptances – Secured Short-Term Financing – Accounts Receivable Financing – Inventory Financing.	(6)

Total 42

TEXT BOOK:

1. Fred Weston J and Thomas E Copeland, "Managerial Finance", The Dryden Press, London, 1982.

REFERENCES:

1. Krish Rangarajan and Anil Misra, "Working Capital Management", Excel Book, New Delhi, 2005.
2. Bhalla V K, "Working Capital Management", Anmol Publications Pvt Ltd, New Delhi, 2003.
3. Srinivasan S, "Cash and Working Capital Management", Vikas Publishing House Pvt Ltd., 1999.

080059 COST MANAGEMENT

3 0 0 3

COST MANAGEMENT - An overview: Definition of Cost Management – Traditional Cost Accounting and Cost Management.	(5)
COST CONCEPTS IN DECISION MAKING.	(4)
VARIABLE (MARGINAL) COSTING: Concepts of Absorption and Variable Costing.	(4)
COST-VOLUME-PROFIT (CVP) RELATIONSHIP: Techniques of CVP Analysis.	(4)
DECISION-MAKING PROBLEMS: Decision-making – types of decision-making problems.	(4)
PRODUCT PRICING DECISIONS: Factors Influencing Pricing Decisions – Different Methods of Pricing.	(4)
BUDGETING: Concept of Budgeting – Concept of Budgetary Control – Objectives and Functions of Budgeting.	(5)
ACTIVITY-BASED MANAGEMENT: Traditional Product Costing – Meaning of Activity-based Costing – Comparing ABC with Conventional Costing System.	(4)
INVENTORY MANAGEMENT: Meaning – Inventory Systems.	(4)
QUANTITATIVE TECHNIQUES FOR DECISION MAKING AND COST MANAGEMENT: LP – PERT – CPM.	(4)

Total 42

TEXT BOOK:

1. Jawahar Lal, "Cost Management", Tata McGraw Hill, New Delhi, 2004.

REFERENCES:

1. Edward J Blocher, Kung H Chen, Gary Cokins and Thomas W Lin, "Cost Management", Tata McGraw Hill, New Delhi, 2006.
2. Bhattacharyya S K and John Dearden, "Costing for Management", Vikas Publishing House Pvt Ltd., New Delhi, 2002.
3. Ronald W Hilton, Michael W Maher and Frank H Selto, "Cost Management", Tata McGraw Hill, 2002.

080060 TECHNOLOGY INCUBATORS AND COMMERCIALISATION OF INNOVATION

3 0 0 3

EVOLUTION OF MANUFACTURING: System of Manufacture - Scientific Management – Process Improvement – Numerical Control – Computer Integrated Manufacturing.	(6)
INNOVATION: Innovation Process – Why R & D – Patents – Capitalizing on R & D – Economic Justification and Innovation.	(6)
OVERVIEW AND PREPARATION: Marketing Innovations – Product Improvements – Technological Innovation – Routes of New Products Development and Its Significance.	(6)
COMMERCIALISATION: Control and Launch Cycle – Marketing Plan – Strategy and Promotion – Product – Price and Distribution – Post-Launch Tracking and Control.	(6)
TECHNOLOGY BUSINESS INCUBATOR: Benefits of TBI – Agencies Involved – Global Scenario of TBI – Indicators of Success for TBI.	(6)

DIFFERENT MODELS OF TBI: Features – Incubation Process – Tenant – Idea – Technology Based. (6)

GLOBALIZING CHANGE: Joint Production versus – Co-Production – Global New Product Launch. (6)

Total 42

TEXT BOOK:

1. Shlomo Maital and Seshadri D V R, "Innovation Management", Response Books, New Delhi, 2007.

REFERENCES:

1. John E Ettlle and Buherworth-Heinemann, "Managing Innovation", Elsevier, New Delhi, 2006.
2. Sudan A S and Naveen Kumar, "Organization Effectiveness and Change", Anmol Publications Pvt Ltd, New Delhi, 2004.
3. Shajahan S, "New Product Strategy and Management", Himalaya Publishing House, Mumbai, 2001.

LANGUAGE

08O061 PROFESSIONAL ENGLISH

3 0 0 3

LEARNING ENGLISH THROUGH LITERATURE: Literary texts drawn from English and American Literature, and Indian writing in English to be used

Short Stories (6)

One Act play (4)

Poetry (6)

Literary Essays (6)

PROFESSIONAL AND SOFT SKILLS TRAINING IN ENGLISH:

Intra & Interpersonal Communication (2)

Interview Techniques (2)

Group Communication (5)

Etiquette – Body Language, Telephone Conversation etc. (2)

Professional report writing (3)

Mass Communication – email writing / public speaking/ presentation techniques/ preparing Advertisements (6)

Total 42

TEXT BOOK:

1. Teaching Material prepared by the Faculty, Department of English

REFERENCES:

1. Bert Decker, "The Art of Communicating", Decker Communications, Inc., USA, 2004.
2. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practice". Oxford University Press, U K, 2004.
3. Dale A Level Jr and William P Galle Jr, "Managerial Communications", Business Publications, INC., Plano, Texas, 1988
4. Albert Joseph, "Writing Process 2000", Prentice Hall, New Jersey, 1996

08O062 INITIATIVE TO GERMAN LANGUAGE

3 0 0 3

INTRODUCTION: Alphabets, Greetings, Vocabulary, Grammar – Pronouns, Verbs and their conjugations, Articles, Question words, Statements and questions, Negation, Countries, Nationalities and Languages. Simple dialogues, Exercises. (10)

POSSESSIVE PRONOUNS: Family, Professions , the verb 'sein', Number system, Nouns – singular and plural. Imperative statements. A small text and dialogues related to family. Exercises. (7)

More irregular verbs, Accusative and dativ declensions of pronouns and articles. Modal verbs and their related grammatical structure. Dialogues and usages of modal verbs. Exercises. (8)

Time and time related particles. Daily routines, related verbs and question words. Related vocabulary and grammar. Sample dialogues and exercises. (8)

Separable and inseparable verbs and their related usage pattern. Invitations and telephone conversations. Exercises. (6)

(FINAL EXAM – Hearing , Oral and Written) (3)

Total 42

TEXT BOOK :

1. To be modeled by the Faculty.

REFERENCES :

1. Tangram Aktuell 1 (Deutsch als Fremdsprache) - Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr - Max Hueber Verlag, 2004.
2. Lernziel Deutsch - Wolfgang Hieber - Max Hueber Verlag, 1983.
3. Grundkurs Deutsch - Roland Schäpers, Renate Luscher , Manfred Glück, 1980.

08O063 BASIC FRENCH

3 0 0 3

INTRODUCTION

(2)

DOSSIER 0 : rencontres, presentations , nationalities - saluer, vous excuser, vous presenter - demander et donner votre identité - computer et peeler des mots - les verbes être, avoir et s' appeler, au present (singulier) -des noms et des adjectives au singulier - C'est + nom ou pronom - // est + adjective - La negation ne... pas - Des phrases interrogatives. (10)

DOSSIER 1: l' arrivée en France - une inscription (a un club de cyclotourisme) - ce qu' on dit en classe (consignes) - Vous informer sur l' identité d'une personne - distinguer les formes – familiales et les formes de politesse - des articles et des adjectives possessifs, au singulier - des mots interrogatifs: quell (adjective), qui (pronoun) ou, comment (adverbs) - des noms de professions. (10)

DOSSIER 2: la famille - quelques personages celebres - presener votre famille et des amis - dire ou sont les gens et d'ou ils viennent - les verbes en-er, être, avoir, faire et venire au present - le plural des noms, des adjectives, des articles et des adjectives possessifs - la negation ne ... pas de + nom - l' interrogation avel est – ce que - a, an et de + nouns de villes et de pays. (10)

DOSSIER 3: maisons et appartements - demenagements, locations, petites annonces – monuments parisiens - situer des meubles et des objects (la localisation) - indiquer la possession - donner des orders et des interdictions - exprimer l' accord et le refus-les verbes en-er, faire, prendre et nettre, au present et a l' imperative - le pronom on - les pronoms toniques après preposition - les adjectives demonstratifs - les adjectives ordinaux - la response si - il ya ... un / des. (10)

Total 42

REFERENCE:

1. Capelle, Guy and Gidon, Noelle. Le Nouvel Escapes. Paris: Hachette Livre, 1998.

08O064 BASIC CONVERSATIONAL SKILLS IN JAPANESE LANGUAGE

3 0 0 3

ORIENTATION: Geographic and socio-economic perspective of Japan, people and culture, basic greetings. Basic scripts – Hiragana and Katakana , sounds and combinations. Basic particles and introductions to demonstratives, place markers and direction markers. (10)

TIME RELATED WORDS: Time of day, days of the week, months and dates of a month. Asking for and telling the time. Verb tenses – Present/future and past. Destination markers, direct object particle and other particles related to mode of transportation and place of action. (10)

ADJECTIVES: Introduction to adjectives, types and negative forms, different usages, comparisons, likes and dislikes. Verbs denoting presence and related particles. Counters and counting suffixes. Sentences involving need and desire, wanting to perform an action and movement for a certain purpose. (10)

VERBS: Groups (I, II and III) and exercises in group verbs. Describing a natural phenomenon, habitual action and a continuing state. Sentences involving asking for and granting permission. (6)

ROLE PLAYS IN JAPANESE: Demonstration on usage of chopsticks – Japanese tea party. (6)

Total 42

REFERENCE:

1. Minna no Nihongo I Honsatsu Roma-ji ban (Main Textbook Romanized version)

DEPARTMENT ELECTIVES

DESIGN ENGINEERING

08M001 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. (5)

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. (5)

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

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

Total 42

TEXT BOOKS:

1. Radhakrishnan P and Kothandaraman C P, "Computer Graphics and Design", Dhanpat Rai and Sons, New Delhi, 2002.
2. Radhakrishnan P and Subramanyan S, "CAD/CAM/CIM", New Age International (P) Ltd., 2002.

REFERENCES:

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw- Hill Inc., New Delhi, 2003.
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. Sadhu Singh, "Computer-Aided Design and Manufacturing", Khanna Publishers, New Delhi, 1998.
6. User's Manuals for ANSYS, ADAMS and Pro/Engineer software, 2003.
7. Rao S S, "Optimisation Techniques", Wiley Eastern, New Delhi, 2003.

08M002 ADVANCED STRENGTH OF MATERIALS

3 0 0 3

CURVED BEAMS : Circumferential stress at a point in a curved beam, Winkler 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. (7)

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. (7)

THICK WALLED CYLINDERS: Lamé 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 frottage. (7)

Total 42

TEXT BOOK:

1. Boreasi A P and Sidebottom O M, "Advanced Mechanics of Materials", John Wiley and Sons, New Delhi, 1985.

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.

08M003 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. (5)

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. (5)

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 (5)

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 42**TEXT BOOKS:**

1. R.B. Gupta, " Automobile Engineering ", Satya Prakashan, 1993.
2. Kirpal Singh, "Automobile Engineering Vol-I & II", 7/e Standard publishers, Delhi, 1997.
3. Heniz Heisler, " Vehicle and Engine Technology, SAE 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", Mc-Graw Hill Book Co., New Delhi, 1976.

08M004 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 (5)

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. (6)

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. (5)

Total 42

TEXT BOOKS:

1. John M Barsom and Stanley T Rolte "Fracture and Fatigue Control in Structures", Prentice Hall, 1987.
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, Ohio, USA, Vol. 10, Tenth Edition, 1995.
3. Michael F Ashby, "Material Selection in Mechanical Design", Butterworth – Heinemann, 1999.
4. T.L.Anderson, Fracture Mechanics:Fundamentals and applications,Second edition

REFERENCES:

1. Shigley and Mische, "Mechanical Engineering Design", McGraw Hill, 1992.
2. Mahmoud M Farag, "Material Selection for Engineering Design", Prentice Hall, 1997.
3. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", DPV Printers, 1993.

08M005 VIBRATION AND NOISE ENGINEERING

(Also common with 08A027)

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. (6)

TWO DEGREES OF FREEDOM SYSTEMS: Generalized co-ordinates, principal co-ordinates, derivation of equations of motion, co-ordinate coupling, Lagrange's equation. (6)

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. (8)

TRANSIENT VIBRATION: Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum. (4)

VIBRATION MEASUREMENT AND CONTROL: 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. (6)

Total 42**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. Rao S S, "Mechanical Vibrations", Addison Wesley, Longman, 1995.
2. 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.
4. Seto, "Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New Delhi, 1990.
5. Kewal Pujara. and Pujara R.S., "Noise for Engineers", Dhanpat Rai and Sons, New Delhi, 1984.

08M006 DESIGN OF ROTATING EQUIPMENT**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. (5)

FANS: Fan laws, performance coefficients, effect of change in fan speed, density, series and parallel operation, fan design losses, blade shape, casing. (5)

PROPELLER FANS: Cross flow fans, principle of operation, applications, regulation of volume flow, sources of vibration in fans, noise attenuation testing. (5)

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 42

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

08M007 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

3 0 0 3

PRODUCT DEVELOPMENT: Human factors and Ergonomics, product development versus design, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method. (8)

PRODUCT FUNCTIONAL REQUIREMENTS: Principles of design, axiomatic approach, functional decomposition, mathematical representation, functional analysis, examples of the use of axiomatic method. (8)

PRODUCT CONCEPTS: Concept generation, product configuration, concept evaluation and selection, product embodiments, Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments (8)

PRODUCT IMPROVEMENT: Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging, factorial analysis-ANOVA, factorial experiments, examples. (8)

PLM CONCEPTS: Introduction to enterprise application integration, CAD and PDM systems CAD-PDM integration, Release to manufacturing- release of engineering data to manufacturing, case studies for PDM-ERP integration, introduction to PLM software and architecture. (10)

Total 42

REFERENCES:

1. Kevin Otto and Kristin Wood Product Design, "Techniques in Reverse Engineering and New Product Development", 1/e, 2004, Pearson Education, New Delhi.
2. Edward B. Magrab, "Integrated Product and Process Design and Development: The product realization process", CRC Press, 1997
3. Karl T. Ulrich, Steven D. Eppinger, "Product Design and Development", Third Edition, 2003, Irwin Professional Publication
4. Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 2002.
5. David Linthicum, "B2B Application Integration: e-Business-Enable Your Enterprise", Addison Weseley, 2001.

08M008 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. (8)

CONSTITUTIVE EQUATIONS: General theory, generalized Hooke's law, equations of elasticity, Mitchel-Beltrami and Navier equations, formulation of the general elasticity problem, boundary conditions. (8)

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. (8)

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. (10)

Total 42

TEXT BOOKS:

1. Timoshenko S P and Goodier J N, " Theory of Elasticity", McGraw-Hill International Editions, Third Edition , 1970.
2. Sokolnikoff I S, "Mathematical Theory of Elasticity", McGraw – Hill International Editions, Second Edition, 1956.
3. Jhonson W and Mellor P B, "Engineering Plasticity", Van Nostrand Reinhold, 1983.
4. Chakrabarthi J., "Theory of Plasticity", McGraw Hill Co, 1987.

REFERENCES:

1. Boresi A P, Schmidt R J and Sidebottom O M, "Advanced Mechanics of Materials", John Wiley and Sons, Inc., Fifth Edition, 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 Editions, Third Edition, 1991.

08M009 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. (7)

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. (7)

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, (7)

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 42**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.
4. Srinivasan, A.V. and Michael McFarland, "Smart Structures", Cambridge University Press, UK, 2001.
5. Kalyanmoy Deb, "Optimization for engineering design", Prentice-Hall India (Pvt) Ltd., New Delhi, 2000.

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.

08M010 BIO-MECHANICS**3 0 0 3**

INTRODUCTION TO BIOMECHANICS: Basic Terminology and Concepts – Mechanical properties of soft tissues, bones and muscles. (10)

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. (12)

BIOMECHANICS OF JOINTS: Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow the Wrist and Hand. (10)

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. (10)

Total 42**TEXT BOOKS:**

1. Susan J Hall, "Basic Biomechanics", The McGraw-Hill Companies, Fifth Edition, Inc., 2006.
2. Jay D Humphrey and Sherry L Delange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer-Verlag, 2004.

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, 1999.

MANUFACTURING ENGINEERING**08M016 COMPUTER INTEGRATED MANUFACTURE**

(Also common with 08A001)

3 0 0 3

INTRODUCTION: Evolution of CAD/CAM and CIM, scope of CIM, segments of generic CIM, computers and workstations, an overview of CIM software. (4)

GEOMETRIC MODELING AND DESIGN OPTIMISATION: Geometric modeling techniques, automated drafting, graphic standards, engineering analysis, optimisation, principles of concurrent engineering. (4)

CNC TECHNOLOGY AND ROBOTIC SYSTEMS: Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC-flexible manufacturing systems. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly. (8)

GROUP TECHNOLOGY AND AUTOMATED PROCESS PLANNING: Methods of developing part families, classification and coding systems, process planning, variant and generative process planning methods, AI in process planning. (6)

MANUFACTURING SYSTEM SOFTWARE: Production control-forecasting, master production schedule, MRP, capacity planning, shop floor control, inventory management, product routing, job costing, marketing applications. (4)

FUNDAMENTALS OF NETWORKING : Networking concepts, networking devices – repeaters, bridges, routers, gateways, hubs and switches. MAP, TOP, LAN, WAN. Network topologies – star, bus, ring. (6)

VIRTUAL ORGANISATION: Paperless factory, introduction virtual reality and application, virtual prototyping and manufacturing instrumentation and measurement, virtual enterprises. (4)

PROJECT: Involving CAD/CAM/CAE activities for a selected product from industry. (6)

Total 42**TEXT BOOKS:**

1. Mikell P Groover, "Automation of Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi, 2001.
2. Lee Kunwoo, "CAD/CAM/CAE Systems", Addison, Wesley, USA, 1999.

REFERENCES:

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall, India, New Jersey, 2003.
2. Radhakrishnan P, Subramanyan S and Raju V, "CAD/CAM/CIM", Second Edition New Age International (P) Ltd, New Delhi, 2000.

08M017 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. (4)

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. (5)

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. (5)

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 tufriding, 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 42

TEXT BOOKS:

1. Watson, "Modern Gear Production", Persman Press Oxford, 1984.
2. HMT, "Production Technology", Tata McGraw Hill Co., New Delhi, 1992.

REFERENCES:

1. SAE, "Gear Design Manufacturing Inspection Manual", SAE, 1990.
2. Weck M., "Hand Book of Machine Tools", Technology and Sons, 1984.
3. "Gear Technology", Magazine – Back Volumes.

08M018 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)

ELEMENTS OF HYDRAULIC SYSTEMS: Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details. (5)

HYDRAULIC SYSTEM DESIGN: Power pack–elements, design. Pipes- material, pipe fittings. seals and packing. maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system (5)

TYPICAL INDUSTRIAL APPLICATION OF HYDRAULIC SYSTEMS: Circuits for deceleration, regenerative circuits, differential circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits. (5)

ELEMENTS OF PNEUMATIC SYSTEMS: Compressors- types, selection. Symbols of pneumatic elements. Cylinders - types, typical construction details. Valves – direction control, flow, pressure, types, typical construction details. (5)

PNEUMATIC SYSTEMS DESIGN: General approach, travel step diagram. Types - sequence control, cascade, step counter method. K.V.Mapping for minimization of logic equation. (6)

TYPICAL INDUSTRIAL APPLICATIONS OF PNEUMATIC SYSTEMS: Metal working, handling, clamping, application with counters. (6)

ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS: Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming (5)

Total 42

TEXT BOOKS:

1. Anthony Espisito, " Fluid Power with Application", Pearson Education (Singapore) Pte.Ltd, Delhi, India, Fifth Edition, First Indian Reprint, 2003.
2. Werner Deppert and Kurt Stoll, "Pneumatic Controls : An Introduction to Principles", Vogel-Druck Wurzburg, Germany, 1975.

REFERENCES:

1. Majumdar, S.R., "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
2. Peter Rohner, "Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples", The Macmillan Press Ltd., UK, 1979.
3. Srinivasan R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints Pvt., Ltd., Chennai, 2004.
4. Sudin Izman and Venkatesh V C, "Precision Engineering", Tata McGraw-Hill Inc., 2007.

08M019 PRECISION ENGINEERING

3 0 0 3

ACCURACY: Concept of accuracy – accuracy of numeric control systems, acceptance test for machine tools. (6)

FACTORS AFFECTING ACCURACY: Static stiffness and its influence on machining accuracy, inaccuracies due to thermal effects, influence of forced vibrations on accuracy, dimensional wear of cutting tools and its influence on accuracy. (7)

MICRO FINISHING PROCESS: Surface roughness, bearing area curves, surface texture measurement, methods of improving accuracy and surface finish, finish boring, finish grinding, precision cylindrical grinding, micro machining, precision micro drilling. (7)

UNCONVENTIONAL MACHINING: Precision, cut in wire, EDM machining, electro mechanical grinding, electron beam machining, laser beam machining. (7)

MICRO ELECTRO MECHANICAL SYSTEMS: Introduction to silicon processing, wafer cleaning, diffusion and ion implantation, oxidation, photolithography, photo resist, resist strip, electron beam and X-ray lithography, thin film deposition, evaporation, sputtering, molecular beam epitaxy, chemical vapour deposition, electro plating. (7)

BULK MICRO MACHINING AND NANO TECHNOLOGY: Wet etching, isotropic etching, anisotropic etching, dry etching, physical etching, reactive ion etching, Nano Technology, nano-grating system, nano-lithography, fabrication of CCDs, nano processing of materials for super high density ICs, nano-mechanical parts. (8)

Total 42

TEXT BOOKS:

1. Murthy R L, "Precision Engineering in Manufacturing", New Age International Publishers, 1996.
2. Mark J Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.
3. Nano Tanigudi, "Nanotechnology", Oxford University Press, New York, 2003.

REFERENCES:

1. Davidson, "Handbook of Precision Engineering", Vol. 1,12, McMillan, 1972.
2. Jaeger R C, "Introduction to Micro Electronics Fabrication", Addison Wesley, England, 1988.
3. Chang C V and Sze S M , "VLSI Technology", Tata McGraw Hill, New Delhi, 2003.
4. Bhart Bhusshan, "Handbook of Nano Technology", Springer Germany, 2004.
5. Website: www.scientific.net
6. Website: www.nist.gov.

08M020 MANUFACTURE OF AUTOMOTIVE COMPONENTS

3 0 0 3

INTRODUCTION: Introduction to basic production process - welding - casting - plastic moulding - powder metallurgy - manufacture of composite materials (1)

MANUFACTURE OF ENGINE & ENGINE COMPONENTS: Introduction - Casting of engine block - drilling of cylinder holes - water cooling passages - Preparation of casting for cylinder heads - design of cores. Forging of crankshafts and connecting rod, casting piston and drilling of oil holes - Upset forging of valves. Heat treatment of crankshafts and connecting rod. Drilling of oil holes and grinding of crank shafts. Forging and heat treatment of camshafts. (7)

MANUFACTURE OF CLUTCH COMPONENTS: Manufacturing friction plates - manufacture of composite friction lining - Composite moulding of phenol formaldehyde lining. (2)

MANUFACTURE OF GEAR BOX COMPONENTS: Casting of gear box casing - Introduction to gear milling - hobbling - manufacturing and inspection of gears (6)

MANUFACTURE OF PROPELLER SHAFT: Casting of propeller shaft. Extrusion of propeller shaft - extrusion dies - heat treatment and surface hardening of propeller shaft. (2)

MANUFACTURE OF AXLES & SPRINGS: Forging of axles, Casting of front and rear axles - Provision of KPI. Wrap forming of coil springs. (3)

MANUFACTURE OF BODY PANELS: Introduction - Thermoforming and hydroforming - Pressforming. Welding of body panels - resistance welding and other welding processes (4)

MANUFACTURE OF AUTOMOTIVE PLASTIC COMPONENTS: Introduction - Principle of injection moulding- injection moulding of instrument panel- moulding of bumpers - tooling and tooling requirements - hand lay-up process for making composite panels - Filament winding of automotive spring and propeller shaft. Manufacture of metal/Polymer/Metal panels. (6)

MANUFACTURE OF ENGINE COMPONENTS USING CERAMIC MATRIX COMPOSITES: Introduction, Ceramic matrix piston rings, Chemical vapour deposition, Cryogenic grinding of powders, Sol-gel processing . (4)

ADVANCED MACHINING PROCESS : Machining concepts using NC, generation of numerical control codes using Pro-E and IDEAS package, interfacing the CNC machine and manufacturing package. Introduction to rapid prototyping - rapid prototyping of using resins. (7)

Total 42

TEXT BOOK:

1. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Company, inc., Third Edition, 1995.

THERMAL ENGINEERING

08M026 COMPUTATIONAL FLUID DYNAMICS

(Also common with 08P021/08A019)

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. (6)

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. (6)

CASE STUDIES: Practical problem solving using CFD packages. (5)

Total 42

TEXT BOOKS:

1. John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, , New Delhi, 1995.
2. Muralidhar K. and Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publications, 2003.

REFERENCES:

1. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
2. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc., 1993.
3. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", Longman, 1995.

08M027 IC ENGINE DESIGN

3 0 0 3

INTRODUCTION: Principles, design of engine based on vehicle characteristics–engine capacity, calculation of bore and stroke length-balancing and vibration -critical speed and damping . (6)

PISTON: Introduction –calculation of gas forces– variation of gas forces. Design of piston – calculation of side thrust – piston pin, rings. (8)

CONNECTING ROD: Introduction–design principles, procedure, selection of cross section, materials, manufacturing process – heat treatment. (7)

CRANKSHAFT: Introduction, determination of primary and secondary forces– balancing forces, calculation of rotating mass, location of mass. Selection of materials, manufacturing process, heat treatment. (8)

VALVE ACTUATING MECHANISM: Design of valves – valve springs – tappet. Cam design-cam profile generation, cam shaft design. Rocker and rocker shaft design considerations, materials, manufacturing process, heat treatments. (8)

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. (5)

Total 42

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.

REFERENCES:

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

08M028 POWER PLANT ENGINEERING

3 0 0 3

STEAM CYCLES: Rankine cycle-superheat, reheat and regeneration, super critical cycles, combined cycles - binary cycles, cogeneration. (4)

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. (4)

HYDROELECTRIC POWER PLANT: Runoff river plants, pumped storage plants, underground stations. Turbine performance, hydel plant auxiliaries 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. (3)

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 42

TEXT BOOKS:

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

REFERENCES:

1. Wakil M M El, "Power Plant Technology", McGraw Hill Book Company Inc., New Delhi, 1985.
2. ArchieWculp Jr, "Principles of Energy Conversion", McGraw Hill Kogakusha Ltd., Tokyo 1979.
3. Ashok V Desai, "Non Conventional Energy", Wiley Eastern Limited, New Delhi, 1990.
4. Nagpal G R, "Power Plant Engineering", Khanna Publishers, New Delhi, 1998.
5. Ramalingam K K, "Power Plant Engineering", Scitech Publication Pvt. Ltd, 2002

08M029 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. (8)

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 H₂S. Origin of H₂S in biogas plants. Effect of H₂S on biogas plant and devices. Determination of H₂S content in biogas. Methods for removing H₂S from biogas. Process techniques. Requirements of absorbent. Desulphurising apparatus. Operation procedures for desulphurization. Scrubbing, storage, transportation. (8)

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. (5)

Total 42

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 Kolin Hochschule, Bremerhaven, Germany, 1985.

REFERENCES:

1. Helmut Mueche/Harald Zimmerman, "The Purification of Biogas", published by Friedr Vieweg and Sohn, Germany, 1985.
2. Ludwig Sasse, "Biogas Plants", published by 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.

08M030 MODELING AND SIMULATION OF INTERNAL COMBUSTION ENGINES

(Also common with 08A014)

3 0 0 3**INTRODUCTION:** First law and second law analysis, governing equation, conservation of mass, momentum and energy. (5)**COMBUSTION IN SI ENGINES:** Combustion in premixed flames - stages of combustion, flame propagation, rate of pressure rise, cycle-to-cycle variation, abnormal combustion - theories, effect of engine operating variables on combustion. (6)**COMBUSTION IN CI ENGINES:** Combustion in diffusion flames - droplet and spray combustion theory, stages of combustion, delay period, peak pressure, heat release, gas temperature, diesel knock. (6)**MODELING OF IC ENGINES:** Heat of reaction - H_{rp} & U_{rp} calculations, adiabatic, constant volume combustion, constant pressure combustion, temperature drop due to fuel vaporization, adiabatic flame temperature, mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions. Spray models, flow models and combustion models. (9)**SIMULATION OF IC ENGINES:** SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions. (9)**SIMULATION OF NEW ENGINE CONCEPTS:** Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine. (7)**Total 42****REFERENCES:**

1. Ganesan V, "Internal Combustion Engineering", Tata McGraw Hill Publishing Co., New Delhi - 2003.
2. Ganesan V, "Computer Simulation of Spark Ignition Engine Process", Universities Press (I) Ltd, Hyderabad, 2001.
3. Heywood J B, "Internal Combustion Engine Fundamentals" McGraw Hill Book Co., USA – 2001.
4. Ganesan V, "Computer Simulation of Compression Ignition Engine Process", University Press (I) Ltd, Hyderabad, 1996.
5. Ramoss A L, "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
6. Ashley Campbel, "Thermodynamic Analysis of Combustion Engines", John Wiley and Sons, New York, 1986.
7. Benson R S, whitehouse.N.D., "Internal Combustion Engines", Paragon Press, oxford, 1979.
8. Ashley S Campbell, "Thermodynamic Analysis of Combustion Engines", John Wiley and sons, 1980.

08M031 ADVANCED THEORY OF INTERNAL COMBUSTION ENGINES**3 0 0 3****CYCLE ANALYSIS:** Operating cycles of S.I. and C.I. engines and Gas turbines - Comparison of Air standard cycle - Fuel air cycle and actual cycle. (5)**SPARK IGNITION ENGINES:** Spark ignition Engine mixture requirements - Carburetion – Electronic fuel Injection systems –single point and multipoint injection. (5)**COMPRESSION IGNITION ENGINES:** Mechanical Injection System- Direct and indirect injection systems - Supercharging, Turbocharging (5)**COMBUSTION OF FUELS:** Combustion stoichiometry of petrol, diesel, alcohol and hydrogen fuels - Chemical energy and heating values - Chemical equilibrium and maximum temperature - SI engine combustion - Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers. Flame velocity and area of flame front - CI engine combustion - Combustion chambers – Fuel spray characteristics - droplet size, penetration and atomization. (9)**ENGINE ELECTRONICS:** Engine Management system, Measurement of Speed, Pressure, Temperature, air flow, exhaust oxygen sensor. (4)**RECENT TRENDS:** Learn Burn Engines - Stratified charge Engines – Low heat rejection engines- Gasoline Direct Injection Engine - Homogeneous charge compression Ignition (4)**ENGINE EMISSION AND THEIR CONTROL:** Pollutant - Sources and types – HC emission- CO emission - formation of NO_x - Particulate emissions – Aldehydes, sulphur, lead, phosphorus emission. Methods of controlling Emissions- Thermal converters, Catalytic converters and Particulate Traps, Exhaust Gas Recirculation (EGR), Charcoal Canister. Emission measurements techniques and Driving cycles. (10)**Total 42****TEXT BOOKS:**

1. John B. Heywood, " Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.

- Ganesan V, "Internal Combustion Engines", Tata McGraw Hill, 2007.

REFERENCES:

- Mathur R B and Sharma R P, " Internal Combustion Engines ", Dhanpat Rai publications, 2000.
- Heinz Heisler, "Advanced Engine Technology", SAE Interanmatinal , 1995.
- Richard Stone, "Introduction to Internal Combustion Engines" , SAE International, 1999
- Domkundwar and Domkundwar, "I. C. Engines", Dhanpat Rai and Sons.

08M032 GAS DYANAMICS AND SPACE PROPULSION

3 0 0 3

BASIC CONCEPTS AND ISENTROPIC FLOWS : Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers –Use of Gas tables. (9)

FLOW THROUGH DUCTS: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalised gas dynamics. (9)

NORMAL AND OBLIQUE SHOCKS: Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl – Meyer relations - Use of table and charts - Applications. (9)

JET PROPULSION : Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors. (9)

SPACE PROPULSION: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights. (6)

Total 42

TEXT BOOK:

- Yahya S M " Fundamentals of Compressible Flow ", New Age International (P) Limited, New Delhi, 1996.

REFERENCES:

- Hill P and Peterson C, " Mechanics and Thermodynamics of Propulsion ", Addison Wesley Publishing Company, 1992.
- Zucrow N J " Aircraft and Missile Propulsion, Vol. I and II ", John Wiley , 1975.
- Zucrow N J " Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, 1970.
- Cohen H , Rogers G E C and Saravanamuttoo, " Gas Turbine Theory ", Longman Group Ltd., 1980.
- Sutton G P, "Rocket Propulsion Elements ", John Wiley, 1986, New York.
- Shapiro A H, " Dynamics and Thermodynamics of Compressible Fluid Flow Vol.kl ",John Wiley , 1953, New York.
- Ganesan V, " Gas Turbines ", Tata McGraw Hill Publishing Co., New Delhi, 1999.
- Thomas E Vollman, Clay Whybark D, "Manufacturing Planning And Control For Supply Chain Management", Tata Mcgraw-Hill, Fifth Edition, 2005.
- Edward B Magrab, Balakumar Balachandran,"Vibrations", Thomson Learning, 2005.
- Shridhara Bhat K, "World Class Manufacturing", Himalaya Publishing House, 2007
- Hans Vanohain and Jack D Mattingly, "Elements of Gas Turbine Propulsion", TMH.

08M033 REFRIGERATION AND AIR CONDITIONING

3 0 0 3

REFRIGERATION: Principles, ideal cycle, Bel, Coleman and Boot strap air cycles, COP calculations. Refrigerants – ECO friendly refrigerants. (6)

VAPOUR COMPRESSION SYSTEM: Thermodynamic analysis, performance of system under varying operating conditions, cascade refrigeration, multistage refrigeration working principles. (6)

VAPOUR ABSORPTION AND OTHER SYSTEMS: Ammonia - water system, Lithium Bromide – water system. use of enthalpy – concentration charts, steam jet refrigeration and solar refrigeration systems. (6)

AIR CONDITIONING: Psychrometry, psychrometer, psychrometric processes, air conditioning cycles, cooling and reheat cycles, by-pass factor – humidification. (6)

COOLING LOAD: Effective temperature, comfort conditions, sensible heat factor ratio, number of air changes, cooling/heating load calculations. (6)

DUCT DESIGN AND AIR DISTRIBUTION: Considerations, methods of duct design air distribution systems, fans and air conditioning systems control. (6)

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

Total 42

TEXT BOOK:

1. Manohar Prasad, "Refrigeration and Air Conditioning" Wiley Eastern Limited, 1983.

REFERENCES:

1. Arora S.C. and Domkundwar S., "Refrigeration and Airconditioning", Dhanpat Rai and Sons, New Delhi, 1997.
2. Stocker, "Refrigeration and Air Conditioning", Tata McGraw Hill Publishing Company Ltd", 1981.
3. Roy J Dossat, "Principles of Refrigeration" S I Verson, Wiley Eastern Limited , 1985.

INDUSTRIAL ENGINEERING**08M039 LEAN MANUFACTURING****3 0 0 3**

INTRODUCTION: Objectives of lean manufacturing-key principles and implications of lean manufacturing- Traditional Vs lean manufacturing – Lean benefits. (5)

LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination- Major kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement / Kaizen- Worker involvement. (5)

GROUP TECHNOLOGY: Part family- Production flow analysis – Composite part concept – Machine cell design -Case studies. (5)

LEAN MANUFACTURING TOOLS & METHODOLOGIES: Standard work -communication of standard work to employees - standard work and flexibility -visual controls-quality at the source- 5S principles -preventive maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction. (8)

VALUE STREAM MAPPING: The as-is diagram-the future state map-application to the factory simulation scenario-line balancing - poke yoka-Kanban – overall equipment effectiveness. (6)

JUST IN TIME MANUFACTURING: Introduction - elements of JIT - Kanban system. (6)

IMPLEMENTING LEAN: Road map-senior management Involvement-best practices. (4)

RECONCILING LEAN WITH OTHER SYSTEMS: Toyota production system-lean six sigma-lean and ERP-lean with ISO9001: 2000 (3)

Total 42**TEXT BOOKS:**

1. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw-Hill, New York, 2004.
2. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
3. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2002.
4. Kenichi Sekine, "One-piece flow", Productivity Press, Portland, Oregon, 1992.

REFERENCES:

1. Joseph A De Feo, William W Bearnard " Juran Institute's Six Sigma Break Through and Beyond", Tata McGraw-Hill Edition, New Delhi, 2004.
2. Richard B Chase F. Robert Jacobs and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGraw-Hill/Irwin; Tenth Edition, 2003.
3. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.
4. Alan Robinson "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 1991.

08M040 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. (9)

Total 42

TEXT BOOKS:

1. Mukhophadyaya 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 Zimmelman. 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

08M041 SUPPLY CHAIN MANAGEMENT

(Also common with 08P017)

3 0 0 3

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

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. (7)

STRATEGIC ALLIANCES: Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor-integration, procurement and out servicing strategies. (7)

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 42**TEXT BOOK:**

1. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, "Designing and Managing the Supply Chain", Tata M.Graw- Hill Publishing Company Ltd, New Delhi, 2003.

08M042 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. (5)

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. (5)

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. (5)

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

BIO THERMODYNAMICS AND BIOENERGETICS: 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 42**TEXT BOOK:**

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.

08M043 PROCESS PLANNING AND COST ESTIMATION

(Also common with 08A004)

3 0 0 3

PROCESS PLANNING- Introduction- Place of process planning-economics- Process & Production Planning, Process Planning & Concurrent Engineering-Types of production- standardization- Production design & selection. (4)

DESIGN AND CONCEPTS OF PROCESS PLAN: Selection of processes, tools, cutting parameters & machine tools- Jigs and Fixtures - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs- Process capability, Process Charts. (5)

MANUAL AND COMPUTER AIDED PROCESS PLANNING: Retrieval type/variant approach, group technology – generative approach, logics decision trees and tables, axiomatic approach – AI expert systems – feature recognition – applications. (6)

ESTIMATING AND COSTING: Concepts, differences, different costing methods – classification of costs – cost grid-problems (4)

DIRECT AND INDIRECT COST COMPONENTS: Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – Direct Labour, Direct Material, Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems. (7)

COST CALCULATIONS: Machined components–welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. **OPTIMUM MACHINING CONDITIONS:** Taylor's equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis. (8)

BREAK EVEN ANALYSIS: Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications. Linear, multi product break-even analysis. (4)

COST MANAGEMENT: : Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications. (4)

Total 42

TEXT BOOKS:

1. Kannappan D, "Mechanical Estimating and Costing", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2003.
2. Kesavon R and others, "Process Planning and Cost Estimation", New Age International (P) Ltd., Chennai, 2005.
3. Banga T R and Sharma S C, "Mechanical Estimating and Costing", Khanna Publishers, New Delhi, 2002.
4. Frederic C Jelen and James H Black, "Cost and Optimization Engineering", McGraw Hill International Book Company, New Delhi, 1983

REFERENCES:

1. Thomas E.Vollmann et al, " Manufacturing Planning and Control Systems ", Galgotia Publications (P)Ltd., Delhi-2,1998.
2. Gideon Halevi and Roland D.Weill," Principles of Process Planning ", CHAPMAN & HALL,UK,1995.
3. Samuel Eilon, "Elements of Production Planning and Control", MacMillan, London, 1985.
4. Haslehurst M, "Manufacturing Technology", ELBS, 1985.
5. ASME, "Manufacturing Planning and Estimation-Hand Book", McGraw Hill, Inc., New Delhi, 1963.

08M044 OPTIMIZATION TECHNIQUES

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 - descent methods – Steepest Descent and Newton Methods. (6)

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, gears, etc. (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. (6)

DYNAMIC PROGRAMMING: Multistage decision process, principle of optimality, algorithms, application to design. (6)

INTEGER PROGRAMMING: Algorithms and applications, Graphical method, the branch and bound technique (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 42

TEXT BOOKS:

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice", Wiley-Interscience, Third Edition, 1996.
2. Stephen G Nash and Sofer A, "Linear and Nonlinear Programming", McGraw-Hill International Edition, 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.

08M045 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. (6)

LOSS FUNCTION: Derivation –use-loss function for products/system- justification of improvements- loss function and inspection-quality evaluations and tolerances-N type, S type, L type. (6)

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. (6)

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 42

TEXT BOOKS:

1. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.
2. Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996.
3. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989.

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.

**08M100 INDUSTRIAL TRAINING I
(MANUFACTURING ORGANIZATION - STRUCTURE AND OPERATIONS)**

0 0 15 4

Industry organization structure, safety and environment needs plant layout - list of machine tools -specifications-operation done on each machine tool - constructional arrangements of machine tools various work holding and tool holding methods types of cutting tools used –hand tools - type of component and material of the component organizational structures – industrial safety – sales and marketing – maintenance – power distribution.

Total 210

**08M200 INDUSTRIAL TRAINING II
(COMPONENT MANUFACTURING TECHNOLOGIES)**

0 0 15 8

Study of components used in lathes, pumps, motors along with needed machine tools, gauges- functions – materials and its importance - study of components drawings – sequence of operations – cutting parameters – cutting tools – geometry of cutting tools – hand tools - gauges and instruments used and the applications – work holding and tool holding methods – jigs and fixtures – job setting procedures – assembling procedures – sequence of assembling for pumps, motors and Lathes.

Total 210

**08M300 INDUSTRIAL TRAINING III
(PROCESS ENGINEERING AND ASSEMBLY TECHNOLOGIES)**

0 0 15 12

Machining, assembly and process engineering - preparation of process sheets for spur gear - helical gear - sprockets - worm - worm wheel and rack - sequence of operations – machine tools used - speed and feed in each type of machine tool-setting time - operating time -cutting tools - Jigs and fixtures - gauges and instruments - study of assembly method for conventional lathe, pre assembly, sub-assembly and final assembly -study of assembly drawings - preparation of ration of loading sheets - assembly flow chart - assembly time - fits and tolerance between components - inspection methods – material flow diagrams.

Total 210

**08M400 INDUSTRIAL TRAINING IV
(INSPECTION AND TESTING OF MECHANICAL ASSEMBLIES)**

0 0 15 8

Inspection and testing of lathes, pumps and motors - BIS specification for motors and pump sets - list of testing instrument - functions - foot mounting motor dimensions as per IS: 1231 - importance of name plate and identification of name plate details - trouble shooting of induction motors - type of routine test of induction motor as per IS : 7538 (Performance Calculations) 1) Measurement of stator resistance 2) High voltage test 3) Measurement of insulation resistance 4) Reduced voltage test 5) No load test 6) Full load test 7) Locked rotor test 8) Starting torque and starting current 9) Pull up torque 10) Pull out torque 11) Momentary over load test 12) Temperature rise test - Final inspection and testing for conventional lathes - Test charts - Inspection of the machine tool for BIS and IMTMA standard - Cutting test - Method of inspection testing - Gauges and instruments required - Accuracy requirements - Deviation observed - Study of inspection methods and preparation of inspection format for lathe bed - Head stock body - Tail stock body - Apron body - Threading and feed box - Gear box - Head stock spindle - Tail stock spindle - Gear - Lead screw - Feed shaft - Spine shaft. – Exposure to metrological aspects of components used for lathes, pumps and motors.

Total 210

**08M500 INDUSTRIAL TRAINING V
(PRODUCT DEVELOPMENT AND QUALITY SYSTEMS)**

0 0 15 12

Total product knowledge, reverse engineering and quality system skill (Mini Project- I), Detailed constructional knowledge of product assembly, sub assembly, components, Sequential assembly and disassembly procedure, capturing of all geometrical dimensions, drawings, tolerances, fits, form error, material of construction and to understand the product development skills for lathes, drilling machines, submersible pumps, mono block pumps& electric motors - Comparison of design construction of other makes for above products and analysis -To develop any new product with innovation & creativity -Report preparation, presentation and evaluation -Awareness of TQM, ISO9000, ISO14000 and other standards etc. - Process capability studies – Rejection analysis – Six sigma applications – Calibration needs – Calibration authorities – Records – Charts – Applications – Form error understanding and verification- Case studies in quality systems.

Total 210

**08M600 INDUSTRIAL TRAINING VI
(DESIGN AND PRODUCTION OF CASTINGS)**

0 0 15 8

Foundry practice, design knowledge of patterns, Moulds, Cores (Mini Project – II), Layout, Pattern shop - Sand plant - Machine moulding - Core shop - Heavy moulding – furnaces -melting-knock-out and shot blasting - fettling -Study of various casting designs- Metallurgy -Inspection-Semi Automation processes-Sand reclamations-Preservations-Rough Machining-Variou allowances- Method Engineering-Computational applications-Planning & Scheduling-Costing-Cleanliness-Orderliness-Environmental requirements-Safety needs-Energy Conservations-Bio Mass Power Generators-DISA Machine operations-Material Handling techniques-Case studies for few selected casting to understand steps to design plan right from pattern to finish casting. Inspection of casting, casting defects and remedies, cause and effects diagram, Rejection analysis.

Total 210

**08M700 INDUSTRIAL TRAINING VII
(MANAGERIAL SKILLS, CREATIVITY, SOFT SKILLS, HRM)**

0 0 15 8

Managerial skills, soft skills and HRM, Generation of creative and innovative ideas, SWOT analysis Executive Skills-Group Discussions-Communication Skills-Project Report preparation methods-Focus on customer needs-Visual Management-Scheduling systems-Maintenance Management-Vendor Developments-Model Preparations-Production, Planning & Controls-Storage & Inventory Management-Supply Chain Management-Lean Methods-Wastage Identifications- Equipment Up Time-Kaizen & Lean Practices, human Resource Management Skills-Innovation & Adaptation Skills- Creative Skills- Patent Right knowledge-Competitive Skills- Interview focusing skills- Product Development Skills- Reverse Engineering Skills- Concurrent Engineering Skills-Prototyping Skills-Costing Skills- Analyzing Skills- Marketability Analysis Skills.

Total 210

**08M800 INDUSTRIAL TRAINING VIII
(INDUSTRIAL VISITS AND COLLOQUIUM I)**

0 0 15 4

Industrial profile - Product range - Catalogue - Infrastructure - Turn over - Quality system - Labor force - Industrial structure - Location - Layout - ISO 9000 and other standards - Material handling system - R & D - Product development - Manufacturing system - Advanced quality systems - Types of industry 1) Auto mobile 2) Foundry 3) Steel 4) Cement 5) Machining 6) Forging 7) Fabrication 8) Electrical. -Industry Lecture-Seminars-Quiz programmes. Training at external industries.

Total 210

**08M900 INDUSTRIAL TRAINING IX
(INDUSTRIAL VISIT AND COLLOQUIUM II)**

0 0 15 4

Visiting external industries and acquiring knowledge about the following productivity enhancement techniques: Focus on customer – Visual management – Scheduling system – Maintenance management – Model preparation – Vendor development – Production planning and control – Storage and inventory management - Supply chain management, Kanban systems – Layout and material handling system – Orderliness – Safety and environment – Equipment uptime- Study and application of KAIZEN, Lean practices, Value Stream Mapping, Value engineering, Zero defects, Wastage identification, Productivity improvement, Continuous Productivity improvement – Reverse engineering – Poka-Yoke, ISO system needs, Knowledge on TQM, TPM and applications. (Training partially at PSG II and partly at other external industries).

Total 210