SCT College of Engineering TVM - 18

# UNIVERSITY OF KERALA

# REGULATIONS, SCHEME and SYLLABUS

**for**

## M.Tech DEGREE PROGRAMME

**(2008 scheme)**

**in**

# MECHANICAL ENGINEERING

**( with effect from 2008 admission)**

**Stream**

**MACHINE DESIGN**

**Offered By**

## DEPARTMENT OF MECHANICAL ENGINEERING

**SCT COLLEGE OF ENGINEERING, TRIVANDRUM**

**KERALA, INDIA**

Pin 695018

**MDM 1001: ENGINEERING MATHEMATICS 3-0-0-3**

1. Beta, Gamma functions, Bessel functions- recurrence relation, generating functions, Legendre's equations and Legendre's Polynomials – recurrence relation and orthogonality property
2. Solution of algebraic and transcendental equations –Bisection method, (b), iteration method, (c) Newton – Ralphson method,

Solution of linear systems i) Direct methods – Gaussian elimination method, Gauss -Jordan methods.

ii) Iterative methods – Jacobi's method, Gauss – Seidel method Solution of systems of nonlinear equations – method of iteration, Newton – Raphson method.Numerical Solution of first order differential equations – Euler method, Runge – Kutta method.

3. Integral transforms - Laplace transforms- Fourier, Millin and Kenkel transforms-inverse transforms-– solutions of initial value problems and boundary value problems by using transforms.
4. Integral Equations- solution of integral equations (i) by transform method (ii) by method of successive approximations, Integro – differential equations.
5. Partial differential equations-The Pfaffian differential equations, parabolic, elliptic and hyperbolic equations, D'Alembert's method. Cannoical form, Characteristics, Green functions, Laplace equation in polar co-ordinates-solution and application.
6. Conformal transformations – standard conformal transformations, translation, inversion, magnifications, Sin z, Cosz , z + 1/z etc. Bilinear transformation and problems, SchwarZ – Christoffel transformations and problems.

References:

1. Integral equations- Santhi Swaroop, Krishna Prakasan Media.
2. Higher Engg. Mathematics-Dr. B S Grewal-Khanna Publishers
3. Higher Engg. Mathematics-N V Bali-Lekshmi Publications-New Delhi
4. Higher Engg. Mathematics-M K Venkataraman-National Publishers Co.
5. Advanced Engg. Mathematics – Erwin Kreyzig
6. Partial Differential Equations-Sneddon
7. Introdrocution to PDE – K. Sankara Rao – Prentice hall of India.
8. Introductory methods of numerical analysis – S.S. Sastry – Prentice hall of India.

**Note: 20% choice may be given while setting the question paper.**

**MDC 1001: THEORY OF VIBRATION 3-0-0-3**

Characteristics of discrete systems components – equivalent springs and dampers – Analysis of free, damped, free and forced SDOF systems – Logarithmic decrement-damping factor- types of damping-frequency response- Phase plane method - magnification factor- Rotating and revolving unbalance – Base excitation – Transmissibility , Seismic Instruments.

Transients – non-periodic excitation of SDOF systems – Impulsive response and Convolution integral – Fourier Integral - Response to periodic excitation – square wave – saw tooth – triangular and half sine wave – even and odd functions. Laplace transforms.

Two degree of freedom systems – normal modes and natural frequencies – Principal co-ordinates. Co-ordinate coupling- – Principal co-ordinates- Idealized car-body vibration - Response to initial excitation – beat- Dynamic vibration absorbers – Centrifugal pendulum absorber – Damped vibration absorber .

Vibration instrumentation – displacement, velocity and acceleration – sensors – electro dynamic and electromagnetic devices – strain gauge accelerometers – Piezo electric accelerometers – Servo accelerometers – digital accelerometers – signal conditioning – shock measurements – vibration exciters – calibration.

References:

1. Meirovitch L : Elements of vibration analysis. McGrawHill
2. Balakumar Balachandran &Edward B Magrab – “VIBRATIONS”.
3. Thomson W.T. :Theory of vibration with Applications. Prentice Hall India
4. Rangan et al., Instrumentation Devices and systems, TMH

**Note: 20% choice may be given while setting the question paper.**

**MDC 1002 : ADVANCED THEORY OF MECHANISMS 3-0-0-3**

Kinematics: Review of determination of velocity and acceleration of points and links in mechanisms-Analytical graphical methods – Use of auxiliary points and special methods for velocity and acceleration determination.

Pole, polode, path curvature, Inflection circle-Euler-Savary Equation-Bobiller theorem- Collineation axis-Hartman's construction-Poldoe curvature.

Synthesis of Mechanisms: The four bar linkage-2 position design – Transmission angle – Angle design for optimum transmission – Coupler curves – Robert's Law Cognate mechanisms.

Analysis of Cams : Basic curves, pressure, angle-Cam size determination-Cam profile determination-Analytical and graphical. Advanced curves-combination of curves-Polydyne cams. Cam dynamics : Cam force analysis-Dynamics of high speed cam system, source of vibration, Follower response-Phase plane method, Johnson's Numerical Analysis – Position error-Jump and cross-over shock, Spring surge and wind up.

Static Force Analysis: Forces, Coupes. Conditions of equilibrium Free body diagram. Analysis of 4-bar linkage, spur gears, Helical ears, Straight bevel gears. Resisting forces. Forces analysis using Coulomb friction, Forces in slider crank mechanism ith friction.

Dynamic Force Analysis of Space Mechanisms: Linear impulse and momentum, Moment of momentums, Components of moment of momentum. Motion of a rigid boy, moments and products of Inertia, Translation of axes. Rotation of axes. Measuring moment of Inertia, Euler's equation of motion. Rotation about a fixed axis, Gyroscopes.

References:

1. Dynamics of Machinery – Holowenko.A.R
2. Kinematics and Linakge Design – Allen S. Hall, Jr.
3. Theory of Machines – Shigley.J.E.
4. Kinematic Synthesis of Linakges – Hartenberg and Denavit
5. Cams – Rothabrt.H.A.
6. Gears – Merit
7. Fundamentals of Mechanical Design – Pahlen.R.M.

**Note: 20% choice may be given while setting the question paper.**

**MDC 1003: MECHANICS OF MATERIALS 3-0-0-3**

Introduction to two-dimensional theory of elasticity-assumptions-stress, strain, displacement-equation of equilibrium, constitutive relations, kinematics relations, compatibility equations, boundary conditions-in Cartesian and pillar coordinates.

Airy's stress function – Saint venant's principle-plain stress and plain strain problems-problem of a cantilever carrying a point load at the free end, problem of a simply supported beam carrying a uniformly distributed lead throughout-Lame's thick cylinder problem, this rotating discs of uniform thickness, solid disc and disc with a central hole, stress concentration, necessity for varying thickness.

Corrosion of prismatic shafts-Semi-inverse method and stress function method- membrane analogy, torsion of a narrow rectangular section.

This rectangular plats-governing differential equation, boundary conditions-Navier solution for a rectangular plate carrying a uniformly distributed load – Tin spherical shell.

Contact stresses-assumptions-cylindrical bodies in lime contact and spherical bodies in point contact. Wave propagation in elastic media-longitudinal waves in prismatic abs, waves of distortion and dilatation in isotropic elastic media.

References:

1. Den Harteg : Advanced Strength of Materials
2. Timoshenko : Theory of Elasticity
3. Seely and Smith : Advanced Mechanics of Materials

**Note: 20% choice may be given while setting the question paper.**

**MDC 1004 : INDUSTRIAL TRIBOLOGY 3-0-0-3**

Introduction to tribology – tribological parameters like friction, wear and lubrication.

Friction: Types of friction-dry-boundary and fluid-laws of friction and friction theories- Friction of metals,ceramic materials and polymers-Variables in friction – Surface cleanliness – effect of pressure, velocity, temperature, vibration etc.

Wear – Classification – theories of ware-stages of ware-adhesive and abrasive ware-factors affecting wear.

Lubrication: Role of lubrication- Lubricants-selection of lubricants- Importance of viscosity and methods for measuring viscosity-fundamentals of viscous flow-flow through capillary tubes between parallel pates-radial flow between parallel circular places – The continuity equation and Reynold's equation.

Bearings-classification and applications- Selection of bearings.

Hydrodynamic bearings : Journal bearings eccentricity-pressure distribution – attitude load carrying capacity –friction and power loss-ideal and real bearings – leakage factors-sommerfield number and design charts. Oil flow and heat dissipation in bearings- Analysis of hydro thrust bearings – Fixed and pivoted shoe bearings.

Hydrostatic bearings : Analysis of oil pads-hydrostatic step bearings-hydrostatic thrust bearing with shoes-role of restrictors-bearing materials and lubricants.

Rolling element bearings : Types-bearings theory-static and dynamic capacities-learning life –selection of bearings-lubrication and mounting of bearings.

References:

1. Radzimovsky : Theory of lubrication of bearings
2. O'Conner and Boyd : Standard Hand Book of Lubrication Engineering McGraw Hill
3. Fuller D.D. : Theory and practice of lubrication for Engineers – John Willey
4. I.M.Hutchings : Tribology-University of Cambridge
5. Gwidon.W.Stachowiak and Andrew.W.Batchelor-Butterworth Heinemann Publishers

**Note: 20% choice may be given while setting the question paper.**

**MDC 1005: FINITE ELEMENT METHOD 3-0-0-3**

Introduction, basic concepts, engineering applications FEM. Comparison with other methods of analysis. General procedure of FEM. Discretisation of Domain, types of elements, interpolation polynomials.

Solid and structural mechanics, basic equations stresses and equilibrium, boundary conditions, strain displacement relations, stress-strain relations, temperature effects, von-mises stress.

One dimensional problems. Formulation of element characteristic matrices- potential energy approach, weighted residual approach. Axial beam element, torsional beam element, bending beam element and generalized beam element. Properties of element characteristic matrix, load vector, transformation matrices, assembly of element matrices and vectors, inco-orporation of boundary conditions-elimination approach, penalty approach, multipoint constraints, solution of finite element equations, computation of element resultants. Natural coordinates systems, Iso-parametric elements.

Introduction to higher order elements- two dimensional problems, constant strain triangles, iso-parametric representation- element stiffness, force terms, stress calculation, temperature effects, orthotropic materials. Axisymmetric solids subjected to axisymmetric loading, two dimensional iso-parametric elements and numerical integration. Three dimensional problems in stress analysis , Hexahedral elements and higher order elements. Finite elements in dynamics-formulation-solid body with distributed mass, element mass matrices. Evaluation of eigen values and eigen vectors. Determination of critical speed of shafts. Rigid body modes.

Finite element program packages. Pre-processing and post-processing, mesh generation.

References:

1. The Finite element methods in engineering, S S Rao
2. Introduction to finite elements in engineering, Thirupathi R.Chandrupatla and Ashok D. Belegundu
3. Elementary Finite Elements Method, Desai C. S.
4. The Finite Element Method, Zienkiewicz O. C.
5. An introduction to the Finite Element Method, Reddy J. N.
6. Applied finite element analysis, Larry J.Segerlind
7. Finite Element Method, R. D. Cook
8. Finite Element Method, C.S. Krishnamurthy
9. Basics of F E M- Solid Mechanics, Heat transfer and Fluid mechanics, Dubuque I A and W C Brown.

**Note: 20% choice may be given while setting the question paper.**

**MDC 1102 PROJECT PART I - - -1**

The student is expected to select and complete the design of the project work. The project has two parts(Part I in semester I and Part-2 in semester -2) . In part 1 the student has to select a project and submit the design phase report for evaluation. The report shall be in soft bonded form. This is the first volume of the Project report. The Second volume is the final project report to be submitted in the second semester. A presentation of the work under taken shall be done before the evaluation committee at the end of the semester.

*The Project shall preferably be hardware / hardware platform based in the area of specialisation.*

Marks: Project Report Evaluation : 25
Presentation & Viva-Voce : 25

MDC 1103 SEMINAR 0-0-2-2

The student has to present a seminar in one of the current topics in the stream of specialisation. The student will under take a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Marks: Seminar Report Evaluation: 25
Seminar Presentation: 25

**MDC 2001: ADVANCED DESIGN SYNTHESIS 3-0-0-3**

Review of Velocity and acceleration Analysis, Use of auxiliary points. Inflection circle, Euler Savery equation the Hartman construction, the Bobillier construction., overlay method for conditioned crank mechanisms, coupler curves.

Geometric methods of synthesis with three accuracy points- poles of four bar linkages, Relative poles, Function generators, poles of slider crank mechanisms, Relative poles of slider crank mechanisms, Rectilinear recorder mechanisms.

Synthesis with four accuracy points- pole triangles, center points, Cardinal points, Pole quadrilaterals.

Synthesis using displacement equations- Freudensteen equation- crank and follower synthesis- three accuracy points

Crank and follower synthesis- angular velocities and accelerations, Synthesis of slider crank mechanisms.

Synthesis using complex numbers

Introduction to synthesis of spatial mechanisms, Robotics.

References:

1. Kinematic synthesis of Linkages by Richard.S.Hartenberg, Jacques Denavit, McGraw Hill
2. book company
3. Kinematics and linkage design by Allen.S. Hall, Pentice Hall of India, Ltd.
4. Theory of Mechanisms and Machines by Shigley, McGraw Hill International Edition.
5. Dynamics of Machinery by A.R.Holowenko

**Note: 20% choice may be given while setting the question paper.**

**MDC 2002: DESIGN OF POWER TRANSMISSION ELEMENTS 3-0-0-3**

Analysis, design and selection of chain drives and belt drives, design of couplings, selection of rolling element bearings.

Classification, theory and operation of friction drives, design considerations.

Gears Transmission – Types of Gears – Speed ratio – Design of Gears. Synthesis of multi speed gear boxes.

Brakes, disk brakes-self actuating brakes fixed, link and sliding anchor drum brakes. Dynamics and thermal aspects of vehicle braking.

Clutches – analysis and dynamics, design of automobile clutch, overrunning clutch.

References:

1. Braking of road vehicles-Newcom and Spurr
2. Design of Machine elements-Vol II-Nieman
3. Design of Machine elements-Reshtov
4. Design of Machine elements-Dobrovolkshy
5. Ground Vehicles- Wong

**Note: 20% choice may be given while setting the question paper.**

# STREAM ELECTIVES OFFERED FOR SEMESTER II

**MDE 2001 : ADVANCED THEORY OF VIBRATION 3-0-0-3**

**3 Periods/Week**

Multi degree of freedom systems –Matrix formulations, Stiffness and flexibility coefficients – Stiffness Matrix of beam elements - Eigen value problems – Orthogonality of Eigen Vectors - Matrix expansion methods –Modal analysis – Normal Mode summation -Matrix iteration methods- LaGrange's Equation – Semi definite systems.

Vibration of continuous systems- Vibration of Strings – Torsional Vibration of Rods – Flexural vibration of beams – Approximate methods - Approximate methods-Raleigh's energy method - Raleigh's Ritz method – Holzer Method – Transfer Matrices- Geared system

Introduction to random vibration- probability theory-harmonic analysis of random signal-auto correlation function-Fourier transformation and spectral density-narrow band-wide band-response

References:

1. Postel and Leckce : Matrix methods in Elasto mechanics
2. L. Meirovitch : Elementary vibration analysis
3. Vibration & Noise for Engineers:W.T. Thomson
4. Mechanical Vibration: W.Seto
5. Balakumar Balachandran & Edward B. Magrab : "VIBRATIONS"

**Note: 20% choice may be given while setting the question paper.**

**MDE 2002: DYNAMICS OF ROTORS 3-0-0-3**

Introduction – Critical speed of rotors –factors affecting critical speed. Stability of rotors under various influences. Vibration of discs, blades and propellers. Torsional vibration of reciprocating machinery. Power smoothing of single and multi cylinder engines. Balancing of rotating and reciprocating machines. Balancing machines.

References:

1. Dynamics of Rotors and Foundations- Erwin Kramer
2. Rotodynamics of turbomachinery-J.Vance
3. Turbo machinery rotodynamics-Darachilds
4. Some problems of rotodynamics-Tondl
5. Analytical methods in rotodynamics-Dimaragonast Pelpetis
6. Rotodynamics-J.S.Rao

**Note: 20% choice may be given while setting the question paper.**

**MDE 2003 : EXPERIMENTAL STRESS ANALYSIS 3-0-0-3**

Stress analysis by strain measurement: Principal stresses and strains. Mohr's circle-measurement of strains-Strain gauges-mechanical optical and electrical gauge construction and applications-Strain rosettes-movie fringe-brittle coating technique.

Variable resistance strain gauges: Gauge characteristics-sensitivity-circulatory for resistance strain gauges- Recording equipments static and dynamic strains- reduction of strain gauge data-compensation-strain measurement over long period at high and low temperature and pressure conditions-measurement of cyclic and transient strains.

Photo elasticity : The Polariscope-stress-optic law-Photo elastic model materials- Polariscope arrangements – Partial fringe value and compensation techniques – use of photo elastic coatings.

Residual stresses: Beneficial and harmful effects – Principle of residual stress measurement methods only.

Non-destructive testings – Types –dye penetrate methods radiography-X-ray and Gamma ray-X-ray fluoroscopy-Penetrameter-Magnetic particle method.

Introduction to lasers in NDT – Ultrasonic flow detection

References:

1. Daily and Litty-Experimental stress Analysis-McGraw Hill
2. Dove and Adams-Experimental stress Analysis and Motion measurement-Prentice hall
3. Hetenyi-Handbook and Experimental stress Analysis-John wiley
4. Perry and Lissener-Strain gauge Primer-McGraw Hill
5. W.J. McGonnagle-Non-destructive Testing-Mc Graw Hill
6. American Society for Metals-Metals Hand Book – Vol.7.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2004 : FAILURE ANALYSIS AND DESIGN 3-0-0-3**

Solution of fracture mechanics. Fatigue testing methods- statistical nature of fatigue data. Theories of fatigue-crack initiation and growth in fatigue; Fractorgraphy. Structure modes and types. Elements of elasticity-linear elastic crack tip fields. Stress intensity stator-energetic of fracture; nery release rate. Small-scale yielding (SSY) crack growth relation in SSY; Stable crack growth in SSY.

Nonlinear fracture mechanics – J integral – Elastic – plastic stationary crack tip fields; ductile structure criterion; J-controlled crack growth ad stability – Tearing modulus – the x factor. Engineering approach to plastic fracture. J-integral – testing single specimen testing; Standard test methods.

Fixed mode mechanics. Recent developments in elastic-plastic fracture mechanics.

References:

1. Advanced fracture mechanics – Kanninen, M.F and Popelar, C.H.
2. Fracture in engineering materials – Knott, J.F.
3. Determination of fracture mechanics of engineering materials – Hortezberg, R.W.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2005: ACOUSTICS AND NOISE CONTROL** 3-0-0-3

Introduction –Basic acoustic principles-acoustic terminology and definitions-Plane waves-harmonic solution-velocity of sound in inviscid fluids-relationship between wave length particle velocity, acceleration – Energy density – acoustic intensity – reference standards and measurement- Transmission through one, two and thee media. Transmission through pipes-branched and unbranched-resonators-Transmission loss reflection at plane surface-standing waves and standing wave apparatus, spherical waves – radiation – simple source –hemispherical source-radiating piston-pressure intensity distribution-Beam width and directivity index-sound absorbing materials.

Noise measurement: Decibel scale-relationship between pressure, intensity and power-sound level meter, noise analyzer and graphic level recorder-measurement in anechoic and reverberation chambers,machinery noise control.

Environmental noise control : Human reaction to sound-definitions of speech interference level, perceived noise level, phon and sone etc, hearing loss-principles of noise control-control at source, during transmission and at receiver-protection of receiver-Acoustic insulation-acoustic materials-acoustic filter and mufflers – plenum chamber-noise criteria and standards- noise and number index guide lines for designing quieter equipments – machinery noise such as pumps, rotating machines, reciprocating machines etc. Methods of control of noise using baffles, coverings, perforations etc. Transmission through structures – control vibration by damping and other methods.

Principles of noise control in an auditorium-requirements of a good auditorium

References:

1. Kinsler and frey – Fundamental sof Acoustics
2. Berenek, L.L. – Noise and Vibration control
3. Harris, C.K. – Handbook of Noise control
4. Petrusowicz and Longmore – Noise and Vibration control for industrialists
5. Thumann and Miller – Secrets of noise control
6. Graf – Industrial noise and vibration
7. R.D.Ford-Introduction to Acoustics
8. Douglas.P.Reynolds-Engg Principles Of Acoustics

**Note: 20% choice may be given while setting the question paper.**

**MDE 2006: DESIGN OF PRESSURE VESSELS AND PIPING 3-0-0-3**

Method for determining stresses – Terminology and Ligament Efficiency- Stresses in pressure vessels– Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical sheets for spherical heads – Thermal stresses- Discontinuity stresses in pressure vessels- Use of codes

Design of vessels ; Design of tall cylindrical self supporting process columns – supports for short vessels – Support for horizontal vessels-Design for wind load- Design for seismic load- Theory of reinforcement .

Bucking -Buckling phenomenon – Elastic buckling of circular ring and cylinders under external pressure – Stiffeners – Stresses in thick walled cylinders- Control and significance of Fracture Mechanics in vessels – FEM application

Piping- Flow diagram- piping elements- piping layout and piping stress Analysis- Flexibility analysis- Codes.

References:

1. John .F.Harvey, 'Theory and Design of Pressure Vessels' CBS Publisher and Distributors ,
2. Henry H bender, " Pressure vessels Design hand Book"
3. ASME Pressure Vessel Codes Section VIII, 1998
4. Dennis Moss Pressure vessel design manual Gulf publishing, 2003.
5. Brownell, L. E., and Young, E. H., Process Equipment Design, John Wiley and Sons,

**Note: 20% choice may be given while setting the question paper.**

**MDE 2007 : ADVANCED MACHINE TOOL DESIGN** 3-0-0-3

General kinematics – design of drives and machine tool elements – design of tool changes and turrets – machine tool dynamics – FEM analysis of machine tool structures. Thermal aspect in machine tool design, machine tool noise and concepts of noise control. Design of slide ways – application of new materials – treatment of slide ways. CNC machine tool structures.

Static and dynamic testing of machine tools. Recent trends in machine tool design.

References:

1. M. Weck, Handbook of Machine Tools, Vol. 1-4, John Wiley, USA.
2. J. Tlusty And F. Koenigsbeger, Machine Tool Strucure, Vol. I, Pergamon Press, UK.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2008: TRANSMISSION MECHANISMS AND MANIPULATORS 3-0-0-3**

Planetary gear trains, speed ratio and efficiency , Simple, compound and coupled trains, assembly conditions, load equalization, multiple speed, differentials, special applications, cyclic gearing, harmonic drive, chain gear train design, synthesis of multi speed gear boxes, universal joints and constant velocity couplings, indexing devices, Geneva mechanism, star wheels and other types, introduction to spatial mechanisms. Kinematic structure and analysis of robot manipulators, gripper theory.

References:

1. Design of Machine elements-Vol II-Nieman
2. Design of Machine elements-Reshtov
3. Design of Machine elements-Dobrovolkshy

**Note: 20% choice may be given while setting the question paper.**

**MDE 2009: DESIGN OF MANUFACTURE 3-0-0-3**

Designing from the manufacturing point of view – Selection of materials and process according workability, accuracy, etc. make/buy decisions, standardization and inter manageability – value engineering and applications – reliability, system reliability, modular sign – Economics of large scale production – estimation of cost of production – case studies.

References:

1. Design for Manufacture- Dieter

**Note: 20% choice may be given while setting the question paper.**

**MDE 2010 : ROBOTICS** 3-0-0-3

Overview of robotic mechanisms and controller – kinematics – position and orientation of objects. Coordinate transformation. Joint variables and position of end effectors. Inverse pneumatic problem. Jacobian matrix.

Dynamics : Lagrangian and Newton-Euler formulations, derivation of dynamic equations. Manipulability – manipulability ellipsoid and manipulability measures. Best configuration of Robotic mechanisms. Dynamic manipulability. Position control – generating the desired trajectory, linear feed back control. Two stage control by linearization and servo compensation. Design and evaluation of servo compensation. Adaptive control. Force control – impedance control – hybrid.

References:

1. Introduction to Robotics , Second Edition , John J. Craig , International Student Edition, AWL.
2. Design of an Interactive Manipulator Programming Environment , UMI Research Press. R. Goldman, 1985.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2011: DESIGN ENGINEERING** 3-0-0-3

Systematic approach to design of engineering systems. Problem definition-constraints- Information collection-sources of information. Engineering innovation. Role of Engineering design in the production, consumption cycle.

Modelling. Influence of human and environmental factors on design: optimization. Applications of the principles of Mechanics, Kinematics, Physical properties of Materials and manufacturing process to optimum design of machine elements and systems. Design of castings, forgings and welded construction. Lightweight construction – value engineering – application to design problems.

References:

1. Woodson T.T. – Introduction to Engineering Design
2. Henry Edel, D. Jr. – Introduction to Creative Design
3. Asimo – Introduction to Design
4. Jones, J.C – Design methods – Seeds of human futures
5. French, M.J. – Engineering Design – The Conceptional Stage
6. Johnson, R.C – Mechanical Design Synthesis with Optimization Applications
7. Mateusek. R. – Engineering Design – A Systematic Approach
8. French M. – Mechanical Engineering Design

**Note: 20% choice may be given while setting the question paper.**

**MDE 2012: OIL HYDRAULICS AND PNEUMATIC SYSTEMS 3-0-0-3**

Introduction-Definitions, units, standards and symbols. Hydraulic systems-elements and accessories, hydrostatic transmission, fundamental switching circuits, electro-hydraulic circuits, servo-hydraulics, design examples analysis of circuits.

Pneumatic systems –Compressed air production and distribution, pneumatic control components, examples of application including electrophenumatic and hydro pneumatic controls, design of circuits.

References:

1. Pippengar, John J. and Koff Richard M : Fluid Power Controls (McGraw Hill)
2. Pippengar, John J. and Hicks Tuler G : Industrial Hydraulics
3. Kirsner, Joseph M : Fluid amplifiers (McGraw Hill)
4. Kirshner, Joseph M. and Silas Katz : Design Theory of Fluidic components (AP)
5. Dr. Heinza Zoebl. Techn : Fundamentals of hydraulic circuitry (London Iiiffe Books Ltd.)
6. Leskiewics H.J. and Zarhmba M: Pneumatic and Hydraulic components and instrumentations in automatic controls.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2013: COMPUTER INTEGRATED MANUFACTURING 3-0-0-3**

Introduction – role of computers in design and manufacture. Wire-frame modeling-representation and data structures. Drafting system – configuration, functions and facilities- parametric representation – examples of drafting systems.

Definition and broad characteristics of Flexible Manufacturing Cells, Systems, Islands and Flexible transfer lines, Place of flexible manufacturing systems in CIM,The FMS relational: Economic and technological justification for FMS

Introduction to Numerical control in computer aided manufacturing – Components of CNC system – Types of CNC systems – Open loop and closed loop control systems, Drives and controls – Interpolators for CNC machine tools – Principal types of CNC machine tools and their constructional features – Design considerations – Tooling for CNC, Adaptive control of CNC machine tools – SMART manufacturing.

CNC part programming – Manual and Computer assisted part programming – Post processors – CNC part programming with CAD / CAM systems.

PLC Ladder, Logic Diagrams , Rapid prototyping , Rapid Tooling.

References:

1. C.B.Besant and C.W.K. Lui: Computer Aided Design and Manufacture, Affiliated East West, INDIA, 1988.
2. J. Rooney and P. Steadman: Principles of computer aided design, Prentice-Hall, INDIA, 1998.
3. M.P. Groover and E.W. Zimmera: CAD/CAM-Computer Aided Design and Manufacture, prentice-Hall, India, 1984.
4. Principles of Computer Integrated manufacturing – S. Kant Vajpayee, PHI
5. Computer Aided Design and Manufacturing – Dr. Sadhu Singh, Khanna Publishers.

**Note: 20% choice may be given while setting the question paper.**

**MDE 2014: ADVANCED THEORY OF ELASTICITY AND PLASTICITY 3-0-0-3**

Revision of two-dimensional elasticity – introduction to three dimensional elasticity-equations of equilibrium, constitutive relations. Kinematic relations, compatibility equations – equations of equilibrium in terms of stains and displacements, compatibility equations in terms of stresses – in Cartesian and cylindrical co-ordinates.

Variational techniques, principle of minimum potential energy-Euler equations-derivation of governing equation and natural boundary conditions for a beam.

Two dimensional examples – pure bending of curved bars, bending of a curved bar bay- force at end, stress concentration around small circular holes in a plate under tension, concentrated force at a point on a straight boundary, force acting at the end of a wedge, circular disc under diametric compression.

Fundamental aspects of general inelastic behavior-plasticity-structural metals under tension, compression and combined stress-yield conditions, Von Misses and Tresca criteria for isotropic metals – loading function.

Examples – expansion of a cylindrical tube, yielding of a symmetrically notched strip in tension. Introduction to viscoelasticty-rheolgocial models – Maxwell model, Kelvin model and the four-element Maxwell-Kelvin model.

References:

1. Timoshenko S. – Theory of Elasticity
2. Filonenko-Borodic – Theory of Elasticity
3. Fluggue W. – Handbook of Engineering Mechanics
4. Prager W. – Introduction to Plasticity
5. Kachanov L.M. – Foundations of Theory of plasticity

**Note: 20% choice may be given while setting the question paper.**

**MDE 2015: CONDITION MONITORING AND MAINTENANCE ENGINEERING *3-0-0-3***

Predictive Maintenance and Signature Analysis- observational and estimational techniques, online techniques specially dealing with instrumentation system, offline technique like visual inspection ,non destructive testing and destructive testing for materials, fluids and general mechanical and electrical components, predictive analysis of potential failures and end of useful life. Diagnostic maintenance, applications to specific industrial machinery and plants.

References:

1. A Guide to the condition monitoring of machines, Department of Industry, HMSO, 1979(Prepared by Micheal Neale & Associates).
2. Vibration monitoring and diagnosis – R.A.Collacott
3. Mechanical Fault diagnosis and condition monitoring-R.A.Collacott
4. First course on condition monitoring in the process industries, Nov 1979,Manchester, edited by M.J.Neale
5. Management of Industrial Maintenance-Newman-Butterworth, March 1978
6. Condition Monitoring Manual-National Productivity council,New Delhi
7. Terotechnology –Institute of mechanical Engineers,1975

**Note: 20% choice may be given while setting the question paper.**

# INTER DISCIPLINARY ELECTIVES

# OFFERED FOR SEMESTER II

**MPI 2001: COMPUTATIONAL FLUID DYNAMICS 3 – 0 – 0 - 3**

System and control volume approaches – velocity, acceleration, Reynold's transport theorem – conservation of mass, momentum and energy equations – Gradient of velocity – deformation and rotation tensors – stress strain relations – Navier – Stoke's equations – Cartesian and polar coordinates(derivation) – Energy equation – Boundary layer equation. Stream function – potential flow – vorticity stream function formulation – potential flow – Turbulence and turbulence modeling.

Finite difference schemes – backward - central and forward schemes – stability analysis – Finite volume method for incompressible flows – Vertex centered and cell centered FVM – Treatment of convection term – Upwind, hybrid, upwind least square reconstruction and QUICK schemes – staggered and collocated grids – solution algorithms for both types – Evaluation of velocity field – SIMPLE, SIMPLER, and projection methods – Time dependent problems – Implicit, Crank-Nicolson and Explicit schemes – Finite volume method for compressible flows-Treatment of convection terms – Flux vector splitting method – Artificial diffusion – Structured and unstructured grids – Solution of system of equations – Tridiagonal matrix algorithm – Line by line solver.

Development of a computer program for the analysis of incompressible flows in two dimensions – solution of few typical problems using the computer program. Study of any two latest papers describing development in CFD.

References:

1. J D Anderson : Computational Fluid Dynamics – Mc Graw Hill International, 1995
2. C A J Fletcher : Computational Techniques for Fluid Dynamics – Vol 1 & 2, Springer Verlag, 1988
3. S V Patankar : Numerical Heat Transfer – Hemisphere, 1980
4. K Muralidhar and T Sundrarajan : Computational Fluid Flow and Heat Transfer, Narosa Publishers, 1996.
5. K.Muralidhar and G.Biswas: Advanced Engineering Fluid Mechanics, Narosa Publishers, 1996.
6. Joel H Ferziger, Milovan Peric : Computational Methods for Fluid Dynamics.

**Note: 20% choice may be given at the time of setting the question paper**

## API 2001: URBAN ENVIRONMENTAL MANAGEMENT

Definition and General consideration of Urban Environment Management, Urban Systems, Management approaches Population, Technology, Management issues. Spatial behaviour, Structural and demographic meaning of urbanization, methods of decomposing urban growth components, level and rate of urbanization, economical demographics of urbanization and mega urbanization, urban poverty and informal sector, Rural and urban impacts f urbanization.

Need for Environmental Management in Cities and Towns, Urbanization, Environment and Human Settlement Policies.

Contemporary urban patterns, trends and problems – Major issues such as population change, the economy, land use, housing, neighbourhood development, fiscal and unemployment crises. International urbanization patterns and policies.

Natural Environment, Built environment and Socioeconomic Environments.

Management of Natural Environment in urban areas, open spaces, vegetation, water bodies, air, water, land, noise, soil etc.

Built environment – Land use planning – Density control, housing, slums, and squatter settlements – Infrastructure – water supply, solid and liquid waste, transportation and other services.

Spatial analysis and Management tools. Life cycle analysis, Environment assessment and reporting. Management control and decision making. Development standards and controls. Environmental Laws, Constitutional Environmental Provisions, Sustainable urbanization policies, environmental policies for sustainable cities.

Sources and effects of urban pollution – Air, Noise, Odour, Water, Wastewater, Land, Solid wastes and toxic wastes and treatment technologies and decision making on urban pollution.

**References**

1. Tony Kendle and Stephen Forbes, “Urban Conservation – Landscape Management in Urban country Side – E & FN SPON, London, 1997.
2. The Royal Commission on Environmental Pollution Report – Transport and Environment – Oxford University Press, 1995.
3. Rob Gray – Accounting for the Environment – Chartered Association of Certified Accountants – 1993.
4. Brain J.L. Berny – Urban Environmental Management

## API 2002: ENERGY ENVIRONMENT & BUILDINGS

Energy Scenario and energy systems in nature – Reasons for the present energy and environmental crisis - Need for the energy and environmental conservation – Study of conventional, non-conventional, renewable, non-renewable energy – passive, active and hybrid systems.

Building climatology (Indian context) – Need of climatically responsive energy efficient buildings – Analysis of climatic data for the building designers both in macro and micro levels. Concept of human comfort – Study and assessment of the factors influencing human comfort – Use of solar passive energy and wind energy in buildings.

Study of the energy conception of buildings - Concept of embodied energy for materials and building components – Requirement of energy for production and operation – energy for maintaining the comfortable internal environment in buildings – Assessment of total energy in buildings.

Factors affecting energy use in buildings – Environmental factors, envelope factors, air conditioning and electrical systems – Energy sources – Energy conservation – Methods and techniques of energy performance assessment of buildings – Aspects of energy management in buildings – Energy audit of buildings.

### References

1. Baker Nick and Steemers Koen, “Energy and Environment in Architecture”, E& FN, Spon. London, 1999.
2. Goulding, John, R, Lewis, Owen J and Steemers, Theo C., “Energy in Architecture”, Bastford Ltd., London, 1986.
3. Bansal Naveendra K., Hauser Gerd and Minke Gernot, “Passive Buildings Designs : Handbook of Natural Climatic Control”, Elsevier Science, Amsterdam 1997.
4. Givonji B., “Man, Climate and Architecture”, Elsevier, Amsterdam, 1986.
5. Smith R.J., Philips, G.M., Sweeney, ‘Environmental Science”, Longman Scientific & Technical, Essex, England, 1982.
6. Watson Donald, ‘Climatic Design : Energy Efficient Building Principles & Practices”, Mc Graw Hill Book company, New York, 1983.

## API 2003: ENERGY EFFICIENCY AND MICROCLIMATE

Climatic impact of landscape elements. Climate and man. The Climatic impact of natural elements – land, land forms, vegetation & water. Thermal properties of commonly used building materials for outdoor spaces.

Site selection, siting & orientation for energy conservation. Human comfort levels. The climatic regions & human adaptation. Site analysis processes & technologies. Site selection for energy conservation. Siting & orientation for energy conservation.

Site planning and design for energy conservation – Integration of building & site for energy conservation. Site planning for energy conservation. Site design for energy conservation.

Modification of micro climates – Selection & use of landscape elements for microclimatic modification. Radiation modification using modification, temperature, humidity and precipitation modification.

Conservation of water – water conserving landscape design. Conservation of embodied energy through landscape design. Quantitative determination of human thermal comfort in outdoor spaces. Eco-sensitive and sustainable landscape.

### References

1. Gray O. Robinette, “Landscape Planning for Energy Conservation”, Van Nostrand Reinhold New York, 1984.
2. Geiger R., “The Climate Near the Ground”, Harward University Press, Cambridge, Massachusetts – 1965.
3. Mc. Pherson E.G. “Energy Conserving Site Design”, American Society of Landscape Architecture, 1984.
4. Mebsh W.M.’ “Landscape Planning Environmental Applciation”, John Wiley & Sons Inc. New York. 1999.
5. Oke T.R., “Boundary Layer Climates” 2nd Edition, Mellhuen & Co. Ltd. London.
6. Robers D. Brown, Terry J. Gillespie, “Microclimatic Landscape Design”, John Wiley & Sons.

## API 2004: RURAL PLANNING & DEVELOPMENT

Rural society in India, characteristics of rural people – structure of rural society – physical planning – typology, forms and structure of rural settlement. Gandhian Approach to Rural Development – Relevance of rural area for urban development, mutual dependence between urban and rural areas, between industry and agriculture – Characteristic of symbiotic development and the pattern of urban development in India.

Causes of rural poverty – Causes of economic and social changes – The policies and measures taken by the government of India to combat poverty in rural areas – Rural housing in India.

Levels of living standards of rural people in different regions of India – National planning and rural development concepts of planning for rural settlement. Regional development and urban rural partnership. Planning principles and village and community norms.

Rural Infrastructure problem – Rural reconstruction – Basic needs and rural sanitation – water supply – hygiene and drainage – technology transfer and options.

Area, district and block level development planning and implementation – public participation in rural development process – Role of voluntary organisations in rural development.

Rural energy issues, renewable and alternative sources of energy – ecological and environmental considerations in rural development and village planning – Sustainable village development – Village institution & rural management problems.

### References

1. T.K. Oommen, “Social Transformation in Rural India – Mobilization and State Interbention”, Vikas Publishing House Pvt. Ltd., 1984.
2. Dr. Kumar, “Rural Sociuology”, Lakshmi Nanain Agarwal, Educational Publichsers, Agra 2.
3. J.B. Chitambar – Introductory Rural Sociology – Wiley Eastern Ltd. India, 1993.
4. Saita Anama Sharma – Rural Settlements – A Cultural Ecological Perspective – Inter India Publications.

## CSI 2001 Finite Element Analysis 3-0-0-3

Preliminaries - Strain displacement relations - constitutive relations - Energy principles - Principle of virtual work - Total potential energy - Rayleigh-Ritz method - method of weighted residuals.

Introduction to FEM - out line of the procedure -Element properties - polynomial form - shape function form - equilibrium and compatibility in the solution - convergence requirements.

Developments of shape functions for truss, beam and frame elements- constant strain triangle -Linear strain triangle -Bilinear plane rectangular elements -Consistent nodal loads - lumped loads-patch test - - stress computation

Isoparametric formulation - Line element- Plane bilinear element- Isoparametric formulation of Quadratic plane elements - Subparametric elements and superparametric elements - Gauss quadrature - Pate and shell elements.

Solution techniques, Large systems of equations - Storage schemes- Solution techniques – Discussion of Finite Element programs and packages

Application of FEA in various fields of engineering

**References:**

1 Cook R.D, *Concepts and Application of Finite Element Analysis*, Wiley & Sons
2 Krishnamoorthy C.S, *Finite Element Analysis*, McGraw Hill.
3 Zienkiewicz O.C, *The Finite Element Method*.
4 Bathe K.J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall.
5 Rajasekharan S, *Finite Element Analysis in Engineering Design*, Wheeler.
6 Reddy J.N, *An Introduction to FEM*, McGraw Hill

**Note: 20% Choice may be given while setting the question paper**

## CSI 2002 Theory of Plates and Shells 3-0-0-3

Introduction – Assumptions in the theory of thin plates – Bending of ling rectangular plates to a cylindrical surface

Pure bending of plates – Slope and curvature – Relations between bending moments and curvature – Particular cases of pure bending

Symmetrical bending of circular plates – Differential equation – Uniformly loaded circular plates with simply supported and fixed boundary conditions – Annular plate with uniform moments and shear forces along the boundaries

Small deflections of laterally loaded plates – Differential equation – Boundary conditions – Navier solution and Levy's solution for simply supported rectangular plates - Effect of transverse shear deformation – Anisotropic plates

Deformation of shells without bending – Definitions and notation – Shells in the form of a surface of revolution, displacements – Membrane theory of cylindrical shells

General theory of cylindrical shells – A circular cylindrical shell loaded symmetrically with respect to its axis – symmetrical deformation – General case of deformation of a cylindrical shell- cylindrical shells with supported edges – Shells having the form of surface of revolution and loaded symmetrically with respect to their axis

**References:**


1 Timoshenko S.P. and Krieger S.W., *Theory of Plates and Shells*, Tata Mc Graw Hill.
2 Chandrasekhara K., *Theory of Shells*
3 Fluigge W., *Stresses in Shells*
4 Bairagi N.K., *Plate Analysis*, Khanna Publishers.
5 Kelkar V. S. and Sewell R. T., *Fundamentals of the Analysis and Design of Shell Structures.*, Prentice Hall, Inc.


**Note: 20% Choice may be given while setting the question paper**

## CSI 2003 Advanced Mechanics of Materials 3-0-0-3

Introduction to mathematical theory of elasticity.
Analysis of stress and strain in 3D Equilibrium equations : Strain displacement relations – Compatibility conditions – Stress and strain transformations – Principle stresses and strains – Octahedral planes and stresses. – Constitutive relations.

Boundary value problems of elasticity – Displacement Traction and Mixed types – Equilibrium equations in terms of displacements ( Lame – Navier ) and Compatibility conditions in terms of stresses ( Beltrami – Michell) – Saint Venant's principle.

Two dimensional problems in Rectangular coordinates - Plane stress and plane strain problems – Stress function - Solution by polynomials – Bending of cantilever loaded at free end and bending of simply supported beam by uniform load.

Two dimensional problems in polar coordinates -General equations- Equilibrium equations, Strain displacement relations and Stress strain relations. Biharmonic equations and Airy's stress functions.

Problems of axisymmetric stress distributions –Thick cylinders - Rotating discs –solid disc and disc with central hole

Shear centre in thin walled sections-Shear flow in open thin walled beams – Shear centre for open thin walled beams with one axis of symmetry – Shear centre for open unsymmetric thin walled beams – shear in closed thin walled sections.

Stress Concentrations- Stress concentration factors – Circular hole in an infinite plate under uniaxial tension – Elliptic hole in an infinite plate stressed in directions perpendicular to major and minor axis of hole. Stress concentration factors in combined loading – stress concentration at a groove in a circular shaft. – Experimental techniques for the evaluation of stress concentration factors.

Torsion of prismatic bars- Saint Venant's semi inverse and Prandtl's stress function approach – Torsion of Straight bars – Circular, Elliptic and Equilateral triangular cross section – Torsion of narrow rectangular section.

**References:**

1 Timoshenko.S.P and Goodier.J.N., *Theory of Elasticity*, McGraw Hill
2. Srinath.L.S., *Advanced Mechanics of Solids*, Tata Mc Graw Hill
3. Sokolnikoff.I.S., *Mathematical theory of Elasticity*, Tata Mc Graw Hill
4. Den Harteg, *Advanced Strength of Materials*.
5. Seely and Smith , *Advanced Mechanics of Materials.*
6. Ameen.M., *Computational Elasticity*, Narosa Publishing House
7. Boresi.A.P., Schimidt.R.J., *Advanced Mechanics of Materials* ,John Wiley

**Note: 20% Choice may be given while setting the question paper**

## CSI 2004 Mechanics of composites 3-0-0-3

Introduction – Classification and characteristics of composite materials – Mechanical behaviour – Laminated fibre reinforced composite materials – Advantages of fibre reinforced composite materials.

Macromechanical behaviour of a lamina – Stress–strain relations for anisotropic materials, orthotropic materials and a lamina of arbitrary orientation – Strength concepts of an orthotropic lamina – Biaxial strength theories.

Macromechanical behaviour of a laminate – Classical lamination theory – Laminate stiffness – Stress distribution through the thickness – Force and moment resultants.

Bending and vibration of laminated composite beams and plates.

**References**

1. Lee R. Calcotte, *The analysis of laminated composite structures*, Van Nastrand Reinhold Company
2. Robert M. Jones, *Mechanics of composite materials*, Scripta Book Company.
3. J. N. Reddy, *Mechanics of laminated composite plates ,Theory and analysis*, CRC Press.
4. M.W.Hyer, *Stress analysis of fibre reinforced composite materials*, Tata McGraw Hill.

**Note: 20% Choice may be given while setting the question paper**

## CSI 2005 Random Vibration 3-0-0-3

Probability Theory – Random variables, Probability distribution and density functions – Expected value mean, variance, conditional probability, characteristic functions, Chebyshev inequality, functions of random variable

Random process- concepts of stationary and ergodicity – nonstationary process – auto and cross correlation and covariance functions – Mean square limit, differentiability and integrability – Spectral decomposition, power spectral and cross spectral density functions – Wiener Khintchine relation - Properties of Guassian, Poisson and Markov process. Broad band and narrow band random process – white noise.

Random vibration : response of linear SDOF and MDOF systems to stationary and nonstationary random excitation. Response of continuous systems – normal mode method

Nonlinear random vibration - Markov vector – equivalent linearisation and perturbation methods- Level crossing, peak and envelope statistics – First excursion and fatigue failures - Applications

**References:**


1. Nigam N.C, *Introduction to random vibration*, MIT press
2. Lin Y.K, *Probabilistic theory in structural dynamics*, McGraw Hill
3. Bendat and Piesol, *Random data analysis and measurement procedure*, John Wiley
4. Clough and Penzien, Dynamics of structures, McGraw Hill
5. Nigam N.C and Narayanan S, *Applications of random vibration*, Narosa.


**Note: 20% Choice may be given while setting the question paper**

CEI 2001 **Philosophy Of Technology** **3-0-0-3**

Scope of Technology-Scope and subdivisions of philosophy -scope and historical development of philosophy of science and technology –Ethics and interpersonal relationship in engineering –IQ-Vs EQ-Ergonomics.

Brief study of the evolving world views based on Issac Newton, Albert Einstein, Werner Heisenberg and Stephen.W.Hawking-Cybernetics and systems science-Analytic Vs Systemic approach –Theory of chaos and complexity.

Thoughts on technology: Martin Heidegger, Karl Marx and Mahatma Gandhi.

Philosophy of Architecture, Information Technology and Biotechnology-Gaia hypothesis-Philosophy of Ecology and Environment –Concept of sustainable development –Cost benefit analysis VsEnvironmental Impact Assessment.
Technology revolutions and social changes. Social impact of NanoTechnology

**References:**

1. Abdul Kalam, A.P.J (2002), *Ignited Minds. Viking*.
2. Friedrich Paulson (1999), *Introduction to philosophy*, Anmol Publications.
3. Ilya Prigogire and Isabella tengers(1984), *Order out of chaos*, Bantom books
4. John G MoGuine and Howard Barlow (1951), *An introduction to Engineering Profession*, Addition Wesley.
5. John horgan (1996), *The end of Science*, Helix books.
6. Jonathen Powers (1982), *Philosophy and New physics*, Methuen.
7. Lebia Green (2007), *Tecnoculture*, Atten&Unwin
8. Nataraja, G (1995), *Science and Human Values –in 'Wisdom*, DK Print world.
9. Oroon K (1985), *Science, Society and Philosophy*, Ajantha Publishers.
10. Philip L Alger et.al(1965), *Ethical Problems in Engineering* ,John Wiley and Sons
11. Pradeep.T ,Nana, *The Essentials*, Tata McGraw-hill
12. Stephen Whawking(1998), *A Brief History of Time* ,Bantam Books
13. Journal of the Society for Philosophy and Technology.

**Note: 20% choice may be given at the time of setting the question paper**

## CEI 2002 ENVIRONMENTAL MANAGEMENT 3-0-0-3

Introduction-Man and environment- physical chemical and biological hazards and their adverse effects- environment and biotechnology- environmental ethics- politics and relevance

Interdisciplinary nature of environment: - air environment, water environment, land environment, biological environment-
Nature resources of environment – Renewable resources, Non Renewable resources, continuous resources extrinsic resources-

Characteristics of environment: - hydrology, meteorology, fluid mechanics, material balance, transport and transformation, sound and noise, water chemistry, air, soil, microbiology, energy and material flow.

Sustainable development: – definition economic dimensions- environmental dimension – framework for achieving sustainability, assessment of sustainable performance.

Global environmental issues: - greenhouse effect, ozone layer depletion- global warming – acid rain – deforestation

Tools of environmental management: - EIA life cycle assessment, Environmental audit, Environmental reporting, and standardization of tools.

**References:**

1. Kurian Joseph & R. Nagendran' *Essential Environmental studies'*. Pearson 'education(SINGAPORE) PteLtd Indian Branch,482. F.I E. Patparganj, New Delhi.110092
2. R.F Fuggle and M. A. Rabie,' *Environmental Management in South Africa',* Juta & Co Ltd 1994.
3. SC Bhatia '*Environmental Pollution and Control in Chemical Process Industries',* Khanna Publishers-Naisarak Delhi.

**Note: 20% choice may be given at the time of setting the question paper**

## CEI 2003 Environment And Pollution 3-0-0-3

Introduction to Environment- components of environment –man and environment.

Natural resources- Water, Land, Forest, Mineral, Energy, Food.

Introduction to environmental pollution –General pollutants; types of Pollutants

Pollution-Air, Water, Land, Noise, Thermal, Marine, Pesticide, Radioactive, Plastic.

Pollution Case studies, Population and the Environment. Environmental ethics, Disaster Management.

**References:**

1.P.Aarne Vesilind, *"Introduction to Environmental Engineering"*, PWS Publishing Company.

2.Dr.N.Arumugam & Prof.V.Kumaresan,*"Environmental Studies"*, Saras Publication.

3.Surinder Deswal & Dr.Anupama Deswal, *"A Basic Course in Environmental Studies"*, Dhanpat Rai and Co (P) Ltd.

**Note: 20% choice may be given at the time of setting the question paper**

## CGI 2001 Geotechnical Engineering for Infrastructure Projects 3-0-0-3

Foundations for infrastructure facilities – requirements, types, suitability, selection. Investigation for infrastructure projects: methods, data required, investigation planning, selection of investigation types, obtaining and analysis of field data with special reference to IS code provisions.

Foundations for building infrastructure: Choice between shallow and deep foundations (Piles, wells, large diameter drilled shafts), Types of shallow and deep foundations, selection. Design of deep and shallow foundations for typical cases. Foundations on rocks. Shallow foundations on rock, rock socketed piles, IS code provisions. Equipment for deep foundation construction.

Foundations for power infrastructure: Dams, water conductor system, transmission line towers.

Foundations for transport infrastructure: embankments supporting transport structures, application of soil reinforcement in embankments and retaining walls.

Applications of sheet piles, excavation.

Foundations for marine structures: Forces acting on piles supporting berthing structures and jetties, pile installation for marine structures.

Field tests on foundations: Vertical, lateral, cyclic, CRP, and pullout test for piles, plate load test, and analysis of field test data. Pile integrity testing.

**References:**

1. Tomlinson, *Pile Design and Construction Practic,* Taylor and Francis,
2. Swamy Saran, *Analysis and Design of Substructures*
3. Das, B.M. *Geotechnical Engineering*

**Note: 20% choice may be given at the time of setting the question paper**

## CHI 2001 Fuzzy Sets and Systems in Engineering 3-0-0-3

Fuzzy set-concepts, operation on fuzzy sets, fuzzy numbers, fuzzy relations and equations - membership functions, construction methods - Fuzzy measures-belief, possibility, probability and possibility.

Fuzzy logic-fuzzy rule based systems - fuzzification and defuzzification methods- applications to water resources problems.

Fuzzy decision making-fuzzy linear and dynamic Programming-applications to water resources

References

1. George J Klir, Tina A Folger, *Fuzzy sets, uncertainty and Information*, Prentice Hall Inc,1988.
2. George J Klir, B.yuan, *Fuzzy sets and Fuzzy logic*, Prentice Hall Inc,1995
3. Timothy J Ross, *Fuzzy Logic with Engineering Applications*, Mc Graw Hill, 1995

**Note: 20% choice may be given at the time of setting the question paper**

## CTI 2003 Optimisation Techniques 3 – 0 – 0 - 3

**1.Linear Programming :** Formulation; Basic Properties, Simplex Algorithm, Artificial Variables, Charnes.M.Method,two phase Technique Transportation Problem, Assignment Problem, Solution of Primal through Dual, Dual Simplex method. Bounded variable technique.

(Two questions to be set)

**2.Non Linear Programming**: Multivariable optimization with equality constraints-Lagrange multiplier method.

**3.Dynamic programming:** Characteristics, -Bellmans Optimality principle- shortest path route, forward and backward solution.

**4.Integer Programming :** Formulation of problems with binary variables.

(From 2, 3 and 4, 1½ questions to be set)

**5.Inventory Management :** Inventory Control; Selective control techniques, ABC analysis, Usage Rate, Criticality, Techniques of Inventory Control with known demand, EOQ with uniform demand; with finite rate of replenishment with shortage, limitations.

( 1½ questions to be set)

**6.Theory of Games :** Characteristics-Two Persons Zero sum Games- Maximin Minimax principle-Saddle points- Games without Saddle Points.(One question to be set)

**References :**


1. Frederick, Hiller and Liebermann, *Intro. To Operations Research*, Holden Day, Calif USA
2. Paul. J Ossenbruggen, *Systems Analysis for Civil Engineers*, John Viley.
3. Ravindran & Philips, *Operations Research*, John Viley.2
4. Taha,H A *Operations research An introduction* P.Hall India Delhi.
5. Hiller FS & Lieberman G J *Introduction to Operations research*


**Note: 20% choice may be given at the time of setting the question paper**

**CMI 2001** **3-0-0-3**

## Personnel Management

Personnel management in organizations – definitions – functions – changing role of personnel management – analysis and design of jobs – human resources planning – procurement – recruitment and selection – induction placement – training and development.

Behavioural science aspects – motivation of individuals – theories of motivation – foundation of group behaviour – leadership – leadership theories – communication – factors affecting communication – channels of communication – group decision making- Foundations of organizational structure – organization design.

References.

1 Organisational behaviour – Concepts, controversies and applications – Stephen P. Robbins, Prentice Hall of India Pvt. Ltd, New Delhi.
2 Organisational Behaviour – Fred Luthans, McGraw Hill Book Company.

## MII 2001 : HEURISTICS FOR OPTIMIZATION 3 – 0 – 0 - 3

Introduction to evolutionary computation: Biological and artificial evolution, Evolutionary computation and AI, different historical branches of EC. Genetic Algorithms: Coding, Search operators, Selection schemes, Applications.

Simulated Annealing: Theoretical Approaches, Parallelization, Applications.

Tabu Search: Neighborhood, Candidate list, Short term and Long term memory, Applications
Ant Colony Algorithms: Overview, Basic algorithm, Variants, Formalization and properties of ant colony optimization, Applications.

Multi objective evolutionary optimization: Pareto optimality, Multiobjective evolutionary algorithms.

References:

1. Baeck T, Fogel D B & Michalewicz Z -Handbook on Evolutionary Computation- IOP Press
2. Michalewicz Z-Genetic Algorithms + Data Structures = Evolution Programms- Springer-Verlag,Berlin
3. Goldberg D E-Genetic Algorithms in Search, Optimization & Machine Learning- Addisson Wesley
4. Banzhaf W,Nordin P,Keller et al.-Genetic Programming :An Introduction- Morgan Kaufmann
5. Yao X-Evolutionary Computation: Theory and Applications- World Scientific Publ.Co,Singapore
6. J.Dreo,A.Petrowski,Eric Taillard-Metaheuristics for Hard Optimization:Methods and case studies-Springer.
7. Tabu Search-Fred Glover
8. How to Solve It:Modern Heuristics- Zbigniew Michalewicz,David B. Fogel-ACM Press
9. AntColonyOptimization-Marco Dorigo Thomas Stützle-MIT Press

**Note: 20% choice may be given at the time of setting the question paper**

**MII 2002: FINANCIAL MANAGEMENT** **3 – 0 – 0 - 3**

Financial management objectives, Financial analysis and planning, balance sheet, income statement, funds flow analysis. Financial ratio analysis, Cost-volume- profit analysis, Operation and financial leverages.

Working capital management, Capital Budgeting, Cost of capital, Capital structure theories, Dividend decisions.

Demand theory and Economic forecasting: Price elasticity, Income elasticity, Cross elasticity. Demand estimation: Time-series analysis, Barometric forecasting, Input/Output analysis.

References
1. I.M. Pandey, Financial Management, Vikas.
2. J.C.T. Mao, Quantitative Analysis of Financial Decisions, MacMillan.
3. H.C. Petersen and W.C. Lewis, Managerial Economics, Pearson Education
4. H. Bierman, Financial Policy Decisions, Macmillan.

**Note: 20% choice may be given at the time of setting the question paper**

**MII 2003 : ORGANISATIONAL BEHAVIOUR** **3 – 0 – 0 - 3**

Dimensions of human behaviour: self development, perception, motivation, personality and leadership-concepts, theories and applications. Modes of values, beliefs, attitudes and intelligents in determining human behaviour. Group dynamics: nature of groups and group decision making. Conflict management , Transactional Analysis .

Organizational development: Concepts of QWL, Organizational change, Goals of organizational change. Concept of organizational climate, health and effectiveness. Organizational culture: nature and characteristics, Motivation of person across cultures, Managerial leadership across cultures. Case studies.

References:

1. Jerry l. Gray, Frederick A. Stark,Organisational Behaviour concepts and applications
2. Fred Luthans ,Organizational Behaviour ,McGraw Hill
3. Stephen P.Robbins ,Organizational Behaviour ,Pearson Education.
4. Uma Sekharan ,Organizational Behaviour-Text and Cases ,TMH

**Note: 20% choice may be given at the time of setting the question paper**

**MII 2004 OPERATIONS RESEARCH** **3 – 0 – 0 - 3**

Introduction to operations research, applications. Linear programming, formulation, solution methods, duality, sensitivity and applications, Integer programming, transportation and assignment problems, Routing problems, traveling salesman problems, Queuing theory, Replacement problems, Sequencing, game theory, decision theory, network analysis, Introduction to simulation, Dynamic programming, goal programming and non linear programming. Case studies illustrating above models in Industries, Introduction to softwares for decisions.

References
1. H.A. Taha, Operations Research: An Introduction, Pearson Education
2 S.S. Rao, Engineering Optimization: Theory and Practice, New Age International Publishers.
.
3 H. M. Wagner, Principles of Operations Research, Prentice- Hall of India Pvt. Ltd.
4 Gross and Harris, Fundamentals of Queuing Theory, John Wiley & Sons

**Note: 20% choice may be given at the time of setting the question paper**

**MII 2005: MANAGEMENT INFORMATION SYSTEMS 3 – 0 – 0 - 3**

Introduction to Information Systems, Establishing the framework, Business models, Information System Architecture, Evolution of Information Systems.

Information Systems: Functional Areas such as Finance, Marketing, Production, Personnel Levels. Types: DSS, EIS, ES, OAS, TPS – Comparison, Concepts and knowledge representation , Managing International Information System.

Information technology infrastructure: hardware, software, managing data resources, telecommunications and networks.

System Development: System development Life Cycle, Structured Methodologies- prototyping, case methodology, Designing Computer based methods, procedures, control.

Implementation and Control: Control, Testing Security, Coding Techniques, Detection of error, Validating, Cost Benefit Analysis, Assessing the value and risk of information systems.

System Audit: Software engineering qualities – design, production, service, software Specification, software metrics, software quality assurance. Systems methodology: objectives, Time and Logic, Knowledge and Human Dimension, software life cycle models – Verification and Validation.

**References:**

1. Kenneth C. Laudon and Jane P Laudon -Management Information Systems –Managing the Digital firm, ,Pearson Education, Asia, 2002.
2. Gordon B.Davis - Management Information System: Conceptual Foundations, Structure and Development, , McGraw Hill
3. Joyce J Elam ,Simon and Schuster-Case series for Management Information Systems'- Custom Publishing, 1996.
4. Steven Alter - Information Systems – A Management Perspective - Addison Wesley, 1999.
5. James A O'Brein - Management Information Systems, Tata McGrawHill, New Delhi,1999.
6. Turban, Mc Lean and Wetherbe - Information Technology for Management-Making connections for strategic advantage, John Wiley, 1999.
7. Ralph M. Stair and George W. Reynolds- Principles of Information Systems -A Managerial Approach, Thomson Learning, 2001.

**Note: 20% choice may be given at the time of setting the question paper**

**MDI 2001: APPLIED FINITE ELEMENT METHOD 3 – 0 – 0 - 3**

Introduction: Historical background, Basic concept of FEM, General procedure of FEM. Engineering applications, Comparison with other methods of analysis, Advantages, Disadvantages, Finite Element software – FE packages.

Finite element modeling, Discretisation of domain, Types of elements, Interpolation functions. Formulation of element characteristic matrices: Axial beam element, torsional beam element, bending beam element and generalized beam element. Properties of element characteristic matrix, load vector, transformation matrices, assembly of element matrices and vectors, boundary conditions, solution of finite element equations, computation of element resultants. Convergence and patch test, One dimensional problems.

Natural coordinates systems, numerical integration, Iso-parametric elements. Two dimensional analysis, Plane stress, Plane strain and Axisymmetric analysis, finite element analysis of plates & shells, Two dimensional iso-parametric elements. Three dimensional problems in stress analysis, Hexahedral elements and higher order elements.

Dynamic Analysis- Element mass matrices, Evaluation of Eigen values and Eigen vectors. Dynamic analysis of spring mass system -solid body with distributed mass, Determination of critical speed of shafts, Rigid body modes.

References:

1. Introduction to finite elements in engineering, Thirupathi R.Chandrupatla and Ashok D. Belegundu
2. Fundamentals of Finite Element Analysis, David Hutton, TMH, 2005
3. A text book of Finite Element Analysis, P.Seshu, PHI, 2005
4. Finite Element Analysis : Procedures in Engineering, H.V.Laksminarayana, Universities press, 2004
5. A first course in the Finite Element Method, Daryl L Logan, Thomson Learning, 2007
6. The Finite element methods in engineering, S S Rao
7. The Finite Element Method, Zienkiewicz O. C.
8. Applied finite element analysis, Larry J.Segerlind
9. Finite Element Method, R. D. Cook
10. Basics of F E M- Solid Mechanics, Heat transfer and Fluid mechanics, Dubuque I A and W C Brown.

**Note: 20% choice may be given at the time of setting the question paper**

**MDI 2002 : ACOUSTICS AND NOICE CONTROL FOR ENGINEERS** 3-0-0-3

Introduction –Basic acoustic principles-acoustic terminology and definitions -velocity of sound in fluids-relationship between wave length particle velocity, acceleration – Energy density – acoustic intensity – reference standards and measurement- Transmission loss reflection at plane surface-standing waves and standing wave apparatus, spherical waves – radiation – simple source –hemispherical source-radiating piston-pressure intensity distribution-Beam width and directivity index-sound absorbing materials.
Noise measurement: Decibel scale-relationship between pressure, intensity and power-sound level meter, noise analyzer and graphic level recorder-measurement in anechoic and reverberation chambers, machinery noise control.

Environmental noise control : Human reaction to sound-definitions of speech interference level, perceived noise level, phon and sone etc, hearing loss-principles of noise control-control at source, during transmission and at receiver-protection of receiver-Acoustic insulation-acoustic materials-acoustic filter and mufflers –. Methods of control of noise using baffles, coverings, perforations etc. Transmission through structures – control vibration by damping and other methods. Principles of noise control in an auditorium-requirements of a good auditorium

References:

1. Kinsler and frey – Fundamental sof Acoustics
2. Berenek, L.L. – Noise and Vibration control
3. Harris, C.K. – Handbook of Noise control
4. Petrusowicz and Longmore – Noise and Vibration control for industrialists
5. Graf – Industrial noise and vibration
6. R.D.Ford-Introduction to Acoustics
7. Douglas.P.Reynolds-Engg Principles Of Acoustics

**Note: 20% choice may be given at the time of setting the question paper**

**MTI 2001: NUMERICAL METHODS** **3 – 0 – 0 - 3**

Solution of algebraic and transcendental equations- Review and comparison of various iterative methods, convergence – Generalised Newton-Raphson method for multiple roots – Higher order methods – Newton's method for non-linear systems.

Solution of simultaneous equatiuons-Direct & indirectmethods-Gauss elimination and Gauss Jordan methods – ill conditioning – pivoting – Jacobi, Gauss-Seidel and Relaxation methods-convergence-Eigen value problems-Vector iteration method.

Interpolation-Newton's Divided difference, Lagrange, Aitken, Hermite and Spline techniques – Inverse interpolation-Error estimates-Double interpolation-Trigonometric interpolation.

Numerical differential- Numerical integration-Newton-Cote's Integration formula-Gauss quadrature-Error estimates-Double integration.

Curve fitting – method of least squares – nn-linear relationships – Correlation and Regression – Linear Correlation – Measures of correlation – Standard error of estimate – Coefficient of correlation – Multiple linear regression.

Solution of ordinary differential equations-Single step & multi step methods-stability of solution – simultaneous first order differential equations- higher order different equations. Numerical solution of integral equations.

Partial eifferential equations – classification – Laplace equation, ID wave equation, ID heat equation – Finite differencemethods – Relaxation methods. Stability and convergence of solution.

Note- Computer program assignments are essential as part of sessional requirements.

Reference:

1. Numerical methods for Scientific and Engineering Computation – Jain M.K.,
2. Elementary Numerical Analysis – Conte and Carl DeBoor
3. Introduction to Numerical Analysis – Gupta A and Bose S C
4. Introduction to Numerical Analysis – Hilderbrand FB
5. Introduction toNumerical Analysis – Fjorberg C E
6. An Introduction toNumerical Analysis – Kendall E Atkinson
7. Statistics – Murrey R Spiegel
8. Numerical Mathematical Analysis – James B. Scarborough
9. Applied Numerical Analysis – C F Gerald & P O Wheatley
10. Numerical algorithms – E V Krishnamurthy & S K Sen

**Note: 20% choice may be given at the time of setting the question paper**

## MRI 2002 ADVANCED NUMERICAL TECHNIQUES FOR ENGINEERING 3-0-0-3

Solution of Simultaneous Linear Equations- Guassian elimination and Guass-Jordan Methods, Matrix inversion, Interactive Method and Relaxation Method. Solution of non-linear equation- Linear interpolation Methods, Newton's Method, Muller's Method.

Numerical Differentiation and Integration-derivatives from Differences Table, Higher-Order Derivatives, Newton-Cotes Integration Formula, Trapezoidal Rule and Simpson's Rule. Solution of Ordinary differential Equation. Taylor- series, Modified Euler Method, Renge-Kutta Method. Boundary- value Problem, Finite element Method- Rayleigh- Ritz Method, Galerke Method, Finite element for Ordinary Differential equation. Optimization techniques-Conventional and Non Conventional. Introduction to MATLAB.

**References:** 1) Applied Numerical Analysis- Gerald/Wheatly, Pearson Education.
2) Numerical Methods using MATLAB, third Edition- John H Mathews, Pearson Education.
3) Numerical Methods Scientific and Engineering Computation- M.K. Jain, S.R.K.Iyengar, R.K. Jain, Wiley Eastern Ltd

**Note: 20% choice may be given while setting the question paper.**

## MRI 2003 TOTAL QUALITY MANAGEMENT 3-0-0-3

Quality and Total Quality-small ‘q’ and Big ‘Q’. tatal Quality Model- internal customer- Imperatives of TQM- Cost of poor Quality-QC. Tools- management Vs Leadership. Six E’s of outstanding leadership- importance of QC due to globalization- Introduction of Quality control- control chart techniques- acceptance sampling- Reliabilty- Reliabilty improvement- maintainability and availability- Quality control in Industry-QC organization. Tools for effective product development. Requirement world class manufacturing. KAIZEN- Continuous improvement- improvement Vs crisis management JIT, Concurrent Engineering TPM, BPR, Quality circle- ISO 9000- Bench Marking- Computer Applications.

**References:** 1) TQM- Paul James (Prentice Hall International)

2) Quality Management – David L.Goetsch & Stanley. B. Davis (Prentice Hall International)
3) Total Quality Management – Dale .H. Basterfield
4) Fundamentals of Quality Control and Improvement- Amitava Mitra
5) Total Quality Handbook- David.L.Goetsch & Stanley.B.Davis
6) Total Quality- Bharat Wakhulu (A.H. Wheeles & Co.Ltd. 1998)
7) TQM & ISO 14000- Dr.K.C. Arrora (S.K. Kataria& Sons)
8) Total Quality Handbook- Tata Steel

**Note: 20% choice may be given while setting the question paper.**

## MRI 2004 OPTIMIZATION TECHNIQUES 3-0-0-3

Introduction, Optimal Problem formulation- Design variable, constraints, Objective function and variable bounds, single variable optimization algorithms- Optimality criteria, Exhaustion search methods, Fibronacci search methods. Multi variable optimization algorithm- Optimality criteria, unidirectional search method, Simplex method, Powell's conjugate direction method. Constrained Optimization algorithm- penalty function method, Sensitivity analysis, Frank-wolf method, cutting plain method, Integer programming.

Non traditional optimization algorithm- Genetic algorithm- Working principle, Building Block Hypothesis, GA Operators- Selection, Crossover and mutation, GA for constrained optimization, Advanced GA operators, implementation of GA, Introduction to Simulated Annealing, Global Optimization using GA and simulated annealing.

**References:** 1) Optimization for Engineering Design, Algorithm& Examples- Kalyanmony Deb.(PHI)
2) Optimization Theory & Application- S.S. Rao
3) Genetic Algorithm in search, Optimization & Machine Learning- Goldberg, D.E.
4) Simulated Annealing and Bolzman's Machine: A Stochastic Approach to Combinational Optimization and Neural Computing- Aarts, E and Korst,J.
5) Handbook of Genetic Algorithm- Davis. C.
6) Engineering Optimization- Methods and Applications- Reklaitis. G.V.
7) Operation Research- Taha, H.A.

Note: 20% choice may be given while setting the question paper.

**TAI 2001 MECHATRONICS 3-0-0-3**

Mechatronics System Design - Integrated Design Issues in Mechatronics, Mechatronics Key Elements, The Mechatronics Design Process, Advanced Approaches in Mechatronics. Sensors and transducers: Introduction-Performance Terminology-Displacement, Position and Proximity-Velocity and Motion-Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

Artificial Intelligence in Mechatronics, Fuzzy Logic Applications in Mechatronics, Microsensors in Mechatronics. Introduction to Modern CNC Machines - Advantages of CNC Machines, CNC Machining Centre Developments, Turning Centre Developments, Part Program Terminology: G and M Codes, Types of interpolation, Methods of CNC part programming, Manual part programming, Computer Assisted part programming: APT language.

Programmable Logic Controller: PLC Programming, Introduction-Basic structure-Input/Output Processing-Programming-Mnemonics-Timers, Internal relays and counters-Data handling-Analog Input/Output-Selection of a PLC. Direct Numerical Control (DNC).

**Reference:**

1. Devdas Shetty & Richard A Kolk - *Mechatronics System Design* – PWS Publishing Company
2. Mechatronics – HMT Ltd., TMH
3. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., *"Mechatronics"*, Chapman and Hall, 1993.
4. Histand Michael B. and Alciatore David G., *"Introduction to Mechatronics and Measurement Systems"*, McGraw Hill International Editions, 2003.
5. Bolton W., *"Mechatronics"*, Longman,Second Edition, 2004.

*For the End semester exam ( 50 marks), the question paper shall have six questions of 10 marks each covering entire syllabus out of which any five shall be answered. It shall have 75% problems & 25% Theory.*
*For the Internal marks of 50, Two test of 20 marks each and 10 marks for assignments (Minimum two) /Term Project.*

## TMI 2001 FUZZY SYSTEMS & APPLICATIONS 3-0-0-3

Introduction to Fuzzy sets and systems. Basics of fuzzy sets, membership function, support of a fuzzy set, height - Normalised fuzzy set, $\alpha$ - cuts (decomposition of a fuzzy set), set theoretic definitions on fuzzy sets, complement, intersection and union equality, subsethood - basic definition based on membership functions. The law of the excluded middle and law of contradiction on fuzzy sets. Properties of fuzzy sets operations (logical proof only). Extension of fuzzy sets concepts - type-2 and level 2 fuzzy sets - examples.

Operations on fuzzy sets - intersection, algebraic sum - product, bounded sum - product, drastic sum product, t-norms and t-conorms(s - norms) on fuzzy sets, typical parameterised t - norms and s-norms(with simplified proof). Extension principle and its applications. Fuzzy relation. Resolution form of a binary fuzzy relation. Operations on fuzzy relations - projection, max.-min. and min and max, compositions cylindric extension. Similarity relations - Reflexivity, symmetry, transitivity. Further operations on fuzzy sets, concentration, dilation, contrast intensification, linguistic hedges.

Logical operations on fuzzy sets – Negation – Conjunction, disjunction, implication, fuzzy inference. Block diagram of a fuzzy logic system. Fuzzy rule base – simplification of compound rule base – fuzzy inference – max. – min, man product, man drastic product, man bounded product. Defuzzification – Centre of gravity, center of sums, weighted average etc. Fuzzy pattern recognition-Feature analysis, Partitions, Identification, Multifeature recognition. Fuzzy control systems- Review of control theory for fuzzy controls, Simple controllers, General controllers, Stability, Models, Inverted pendulum, Aircraft landing control, Aircondioner control.

**References:**

1. C.T Lin & C S George Lee: *Neural Fuzzy Systems*, Prentice Hall. (Module 1, 2, 3)
2. Ahamad M. Ibrahim : *Introduction to Applied Fuzzy Electronics*, PHI. (Module 3)
3. S. Rajasekharan, G A Vijayalakshmi Pai *: Neural Networks, Fuzzy logic and Genetic Algorithms*, PHI.
4. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 2/e, McGraw Hill.

**Reading:**

1. Earl Cox: *Fuzzy Systems Handbook*, Associated Press
2. Klir and Yuan: *Fuzzy Sets and Fuzzy Logic- Theory and Applications*, Prentice Hall of India.
3. Bart Kosko: *Fuzzy Engineering*, Prentice Hall.
4. Bart Kosko: *Fuzzy Thinking* , Hooper Collins Publications.
5. Yen: *Fuzzy Logic: Intelligence, Control and Instrumentation* , Pearson Education, 2002

*For the End semester exam ( 50 marks), the question paper shall have six questions of 10 marks each covering entire syllabus out of which any five shall be answered. It shall have 50% problems & 50% Theory. For the Internal marks of 50, Two test of 20 marks each and 10 marks for assignments (Minimum two) /Term Project*

**TSI 2001 ARTIFICIAL NEURAL NETWORKS 3-0-0-3**

**Introduction to Neural Networks** Biological Neurons and Neural Networks, Networks of Artificial Neurons. Single Layer Perceptrons, Learning and Generalization in Single Layer Perceptrons, Hebbian Learning, Gradient Descent Learning, learning rates, Widrow-Hoff Learning , The Generalized Delta Rule, Practical Considerations

**Basic neural network models** ADALINE networks, LMS algorithm, Learning in Multi-Layer Perceptrons, Back-Propagation algorithms, Radial Basis Function Networks: Fundamentals, Algorithms and Applications, Learning with Momentum, Conjugate Gradient Learning, Bias and Variance. Under-Fitting and Over-Fitting. Applications of Multi-layer Perceptrons.

**Basic learning models** Associative Learning, Competitive Networks, Winner-take-all networks, Adaptive Resonance Theory (ART), Neural networks as associative memories, Hopfield network, BAM, Self Organizing Maps: Fundamentals, Algorithms and Applications. Learning Vector Quantization, Optimization problems solving using neural networks, Stochastic neural networks, Boltzmann machine

**Applications of artificial neural networks:** Application areas like system identification and control, decision making, pattern recognition, and sequence recognition.

**ReferenceS**

1. Simon Haykin, *"Neural Networks"*, second edition, Prentice Hall, 1999

2. Christopher M. Bishop, *Neural Networks for Pattern Recognition* by Oxford University Press, 1995

3. Martin T. Hagan, Howard B. Demuth, Mark Beale, *Neural Network Design*, Vikas Thomson learning

*For the End semester exam ( 50 marks), the question paper shall have six questions of 10 marks each covering entire syllabus out of which any five shall be answered. It shall have 75% problems & 25% Theory.*
*For the Internal marks of 50, Two test of 20 marks each and 10 marks for assignments (Minimum two) /Term Project.*

**EMI2001 BIOMEDICAL INSTRUMENTATION 3 – 0 – 0 - 3**

***Course Objective:*** *To make an introduction to the modern Biomedical instruments and systems, their features and applications*

***Syllabus:***

Introduction to the physiology of cardiac, nervous, muscular and respiratory systems.

*Transducers and Electrodes*

Different types of transducers and their selection for biomedical applications, Electrode theory, Different types of electrodes, reference electrodes, hydrogen, calomel, Ag-AgCl, pH electrode, selection criteria of electrodes.

*Measurement of electrical activities in muscles and brain*

Electromyography, Electroencephalograph and their interpretation.

*Cardiovascular measurement*

The cardio vascular system, Measurement of blood pressure, sphygmomanometer, blood flow, cardiac output and cardiac rate. Electrocardiography, echo-cardiography, ballistocardiography, plethysmography, magnetic and ultrasonic measurement of blood flow.

*Therapeutic Equipment*

Cardiac pace-makers, defibrillators, hemodialysis machine, diathermy.

*Respiratory System Measurement*

Respiratory mechanism, measurement of gas volume, flow rate, carbon dioxide and oxygen concentration in inhaled air, respiration controller.

*Instrumentation for clinical laboratory*

Measurement of pH value of blood, ESR measurements, oxygen and carbon dioxide concentration in blood, GSR measurement

X-ray and Radio isotopic instrumentation, diagnostic X-ray, CAT, medical use of isotopes.

Ultrasonography, MRI

***References:***

1. '*Handbook of Biomedical Instrumentation*'
   - R S Khandpur
   - TMH Publishing Company Ltd. New Delhi
2. '*Introduction to Biomedical Equipment Technology*'
   - Joseph J Carr, John M Brown
   - Pearson Education (Singapore) Pte. Ltd
3. '*Biomedical Instrumentation and Measurements*'
   - Leslie Cromwell
   - Prentice Hall of India Pvt. Ltd, New Delhi

***Prerequisite:*** *Basic knowledge in electronic instrumentation*

**Note: 20% choice may be given at the time of setting the question paper**

**EGI 2001 INTRODUCTION TO NAVIGATION, GUIDANCE AND CONTROL**
**3 – 0 – 0 - 3**

***Course Objective:*** *To impart basic ideas of Navigation and Guidance and control of Aero space vehicles*

## *Syllabus:*

Introduction to the concepts of navigation guidance and control. General principles of early conventional navigation systems. Geometric concepts of navigation. Reference frames. Direction cosine matrix, Euler angles, Quaternion representation in co-ordinate transformation. Comparison of transformation methods, GPS and GNSS.

Inertial navigation- block diagram- inertial sensors-Gyros – Principle of operation-Accelerometer-principle of operation-Inertial platforms-stabilised platforms-gimballed and strap down INS.

Stabilization and Control of space crafts, Missile control systems and Autopilots, Launch vehicle flight control systems. Longitudinal and lateral autopilots for aircraft. Radar systems- Command and Homing guidance systems

### *References:*

1. *Modern Inertial Technology second Edition*
   - Anthony Lawrence Springer-Verlag
   - New York, Inc, 1998.
2. *Aerospace Avionics Systems- A Modern Synthesis*
   - George M Siouris-
   - Academic Press, Inc.
3. *Modern Navigation, Guidance, and Control Processing-*
   - Ching-Fang –Lin-
   - Prentice-Hall Inc, Engle Wood Cliffs, New Jersey, 1991
4. *Inertial Guidance Engineering-*
   - Manuel Fernadez and George R Macomber-
   - Prentic-Hall, Inc., Engle Wood Cliffs, New Jersey, 1962
5 *Automatic Control of Aircraft and Missiles*
   – Blaklock J H
   – Wiley, 1990

**Note: 20% choice may be given at the time of setting the question paper**

## EPI 2001 ENERGY CONSERVATON AND MANAGEMENT 3 – 0 – 0 - 3

***Course Objective:*** This *subject provides essential input to equip engineers of any discipline suitable to take up responsibility of an energy manager in any organization*

***Syllabus:***

*Energy conservation management*

The relevance of energy management profession; general principles of energy management and energy management planning; application of Pareto's model for energy management; obtaining management support; establishing energy data base; conducting energy audit; identifying, evaluating and implementing feasible energy conservation opportunities; energy audit report; monitoring, evaluating and following up energy saving measures/ projects.

*Energy efficiency*

Energy efficiency analysis; thermodynamics and energy; coefficient of performance; energy effectiveness; management of heating, ventilating and air-conditioning (HVAC) – principles, opportunities, case studies; management of process energy- principles, opportunities, case studies; management of electrical load and lighting - management opportunities with electric drives, lighting, heating and electrolytic systems; electrical load analysis; peak demand control; computer-aided energy management; cogeneration; forms of cogeneration; feasibility study for cogeneration.

Energy efficiency of turbines, compressors and pumps; specific energy consumption; parameters affecting specific energy consumption; flexi targeting technique.

*Energy economics*

Financial evaluation of energy projects; cash flow model; time value of money; evaluation of proposals - payback method, average rate of return method, internal rate of return method, present value method, profitability index, life cycle costing approach, investment decision and uncertainty; consideration of income taxes, depreciation and inflation in investment analysis.

***Text-books:***

1. '*Industrial energy conservation*'
   - Charles M Gottschalk
   - John Wiley & Sons, 1996
2. '*Energy management principles*'
   - Craig B Smith
   - Pergamon Press

***References:***

1. IEEE recommended practice for energy management in industrial and commercial facilities, IEEE std 739 – 1995 (Bronze book)
2. '*Optimizing energy efficiencies in industry*'
   - G G Rajan
   - Tata McGraw Hill, Pub. Co., 2001
3. '*Energy management*'
   - Paul O'Callaghan
   - McGraw Hill Book Co
4. '*Energy management Hand Book*'
   - Wayne C Turner
   - The Fairmount Press, Inc., 1997
5. '*Energy Technology*'
   - S Rao and B B Parulekar
   - Khanna Publishers, 1999

***Pre-requisite:*** *General background of any Engineering Degree will be sufficient to learn this subject*

**Note: 20% choice may be given at the time of setting the question paper**

**ECI 2003 ENGINEERING OPTIMIZATION 3 – 0 – 0 - 3**

***Course Objective:*** *Course offers different optimization procedures to solve a wide variety of problems which can be applied to different fields*

**Syllabus:**

Concepts of optimization: Statement of optimization problem - Classification -Engineering applications. Linear Programming- Graphical method- Simplex method –Duality- Sensitivity analysis -Transportation and assignment problems.

Nonlinear programming- Unconstrained optimization techniques-Direct search methods- Descent methods -Constrained optimization - Direct and Indirect methods - Kuhn tucker conditions.

Dynamic programming- Multistage decision process -Concept of sub optimization and Principle of optimality -Computational procedure

Advanced optimization techniques- Genetic Algorithm -Simulated annealing methods- Optimization programming.

***Text books:***

1. '*Engineering optimization, Methods and Applications*'
   - G V Reklaitis, A Ravindran & K M Rajsdell
   - John Wiley & Sons
2. '*Engineering Optimization Theory and Practices*'
   - Singiresu S Rao, John
   - 3rd Edition, Wiley and Sons, 1998

***References:***

1. '*Operations Research - Principles and Practice*'
   - A Ravindran, Don T Philips and Jamer J Solberg
   - John Wiley & Sons
2. '*Practical Optimization*'
   - P G Gill, W Murray and M H Wright
   - Academic Press, 1981
3. '*Introduction to Operations Research*'
   - Fredrick S Hiller and G J Liberman
   - McGraw-Hill Inc 1995
4. '*Optimization Concepts and Applications in Engineering*'
   - Ashok D Belegundu, Tirupathi R Chandrapatla
   - Pearson Education, Delhi, 2002

***Prerequisite:*** *Knowledge in matrix algebra and differential calculus.*

**Note: 20% choice may be given at the time of setting the question paper**

## MCC 3101 Research Methodology

Introduction – Meaning of research – Objectives of research – Motivation in research – Types of research – Research approaches – Significance of research – Research methods vs Methodology – Criteria of good research.

Defining Research Problem – What is a research problem – Selecting the problem – Necessity of defining the problem – Literature review – Importance of literature review in defining a problem – Critical literature review – Identifying gap areas from literature review

Research design – Meaning of research design – Need– Features of good design – Important concepts relating to research design – Different types – Developing a research plan

Method of data collection – Collection of data- observation method – Interview method –Questionnaire method – Processing and analysis of data – Processing options – Types of analysis – Interpretation of results

Report writing – Types of report – Research Report, Research proposal ,Technical paper – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Simple exercises – Oral presentation – Planning – Preparation – Practice – Making presentation – Answering questions - Use of visual aids – Quality & Proper usage – Importance of effective communication - Illustration

**References**

Coley S M and Scheinberg C A, 1990, "Proposal Writing", Newbury Sage Publications.

Leedy P D, "Practical Research : Planning and Design", 4th Edition, N W MacMillan Publishing Co.

Day R A, *"How to Write and Publish a Scientific Paper"*, Cambridge University Press, 1989.

# STREAM ELECTIVES OFFERED FOR SEMESTER III

**MDE 3001: INDUSTRIAL DESIGN** **3-0-0-3**

Reliability Engineering: Meaning of measurement and improvement of reliability – effect of environment system of reliability – availability and maintainability – Design consideration for reliability achievement and improvement.

Value Engineering: Importance of simplification and standardization in designs – value analysis, development and choice of calculation of savings achieved. Techniques of value analysis and engineering.

Applied ergonomics: Human being in man made world. Gross human anatomy, anthropometrics, static and dynamic, muscles and work physiology, static and dynamic work including maximum capacity. Biomechanics, environmental condition including thermal, illumination noise and vibration, biological transducers and nervous system including their limitations. Controls and displays psycho physiological aspects of design. Research techniques in ergonomic data generation. Intepretation and application as statistical methods.

References:

1. Concepts in Reliability – L. Sreenath (Affiliated East West Press)
2. Human factors in Engineering Design – E.J.McCormick
3. Ergonomics – K.F.H. Murrel
4. Value Engineering – Mudge (McGraw Hill)

**Note: 20% choice may be given while setting the question paper.**

**MDE 3002: COMPOSITE PRODUCT DESIGN 3-0-0-3**

Basic Definitions and Classification of Composites - Basic definitions, Various types of composites.-Basic constituent materials in Composites , Composite Manufacturing Processes.

Micromechanical Behavior of a Lamina- Volume and Mass Fractions, Density and Void Content , Evaluation of the Four Elastic Moduli, Ultimate Strengths of a Unidirectional Lamina, Thermal Expansion Coefficients, Moisture Expansion Coefficients

Macromechanical Behavior of a Lamina- Hooke's Law for Different Types of Materials, Hooke's Law for a Two Dimensional Unidirectional Lamina, Hooke's Law for a Two Dimensional Angle Lamina, Engineering Constants for an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina, Strength Failure Theories of an Angle Lamina - Determination of Laminate Mechanical Properties.

Macromechanical Analysis of a Laminate -Laminate Code, Stress-Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygrothermal Effects in a Laminate.

Failure, Analysis and Design of Laminates - Design methods as applied to composite materials/products – working stress method – probabilistic method – ultimate strength method – fracture mechanics approach. Design of bolted and adhesive joints, design of sandwiched structures.

Testing of Composites Mechanical testing of composites, Tensile testing, Compressive testing, Intralaminar and Inter laminar fracture and shear testing etc.

References:

1. R. M. Jones,- Mechanics of Composite Material, McGraw Hill Publishing.
2. S.S. W. Tsai, Composites Design, Think Composites, 1986.
3. B. D. Agrawal and L.J. Brountman, Analysis and Performance of Fiber Composite, Willey New York, 1980.
4. Geoff Eckold, Design and Manufacture of Composite Structures, Wood –heed, Publishing Limited, Combridge, England, 1994.
5. Stephen W.Tsai and H. Thomas Hahn, ‘Introduction to Composite Material”, Technomic Publishing Company, Inc. Lancaster, 1980.
6. J. N. Reddy and A.V. Krishna Moorty, “Composite Structures, Testing, Analysis and Design Narosa Publishing House, New Delhi., 1992.

**Note: 20% choice may be given while setting the question paper.**

**MDE 3003: EXPERIMENTAL METHODS 3-0-0-3**

Basic concepts of measurement methods and planning and documenting experiments. Typical sensors, transducers, and measurements system behavior Data sampling and computerized data acquisition systems.

Statistical methods and uncertainty analysis applied to data reduction.

Procedures for hypothesis testing, means, proportions, variances, contingency, goodness of fit of data to a proposed model. Use of hypothesis tests to compare products or processes.

Principles of experimental design: randomization, replication, blocking. Analysis of variance: one-way and two-way analyses, with and without interaction. Cross-classified and nested forms. Fixed and random effect models. Factorial experiments versus one-at-a time experiments.

Simple and multiple regression analysis. Use of transformation, analysis of residuals, variable selection procedures.

References:

1. Experimental Methods for Engineers, J. P. Holman, McGraw-Hill Education (2000) ISBN 0071181652.
2. Experimental Methods: An Introduction to the Analysis and Presentation of Data, L. Kirkup, Wiley Text Books (1995) ISBN 0471335797.
3. Experimental Physics: Modern Methods, R. A. Dunlap, Oxford University Press (1988) ISBN 0195049497.
4. Experiments in Modern Physics, 2nd Edition, A. C. Melissinos, Academic Press (2003) ISBN 0124898513.
5. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, 2nd Edition, J. R. Taylor, University Science Books (1997) ISBN 093570275X.

**Note: 20% choice may be given while setting the question paper.**

**MDE 3004: COMPUTATIONAL METHODS IN DESIGN AND MANAUFACTURE 3-0-0-3**

Review of equations of mechanics – analysis of stress, strain and strain rate, energy principles. Elastoplasticity – yield criteria, incremental and deformation plasticity, flow rule, viscoplasticity.

Finite element method-procedure, elements and shape function, stiffness, matrix, isoperimetric simulations, assembly and solutions. Examples of applications in mechanical design.

Nonlinear analysis – total and updated lagrangian formulations, geometric nonlinearity and material nonlinearity-formulations and procedures for static analysis.

Applications of FEM to metal forming ad metal cutting- forging, extrusion and sheet metal forming – mesh rezoning, heat transfer analysis – computational procedures or thermo plasticity.

References:

1. O.C. Zienkiewicz and R.L. Taylor: Finite Element method, Vol.1, Basic formulation and linear problems, McGraw Hill Int.Edn., 1989.
2. J.N. Reddy: Energy and Variational Methods in Applied Mechanics, John Wiley and Sons, Inc., USA, 1984.
3. R.D. Cook:Concepts and Applications of Finite Element Analysis, John Wiley, USA, 1989.
4. Dr.J.J.Owen And E. Hinton: Finite Element in Plasticity – theory and practice, Pineridge press, USA, 1986.
5. S.Kobayashi, and T. Atlan:Metal forming and Finite Element method, Oxford University press, UK, 1989.

**Note: 20% choice may be given while setting the question paper.**

**MDE 3005: ADVANCED COMPUTER GRAPHICS 3-0-0-3**

Overview of Graphic systems , Graphic primitives- Line , circle, ellipse – Geometric transformations – Two dimensional transformations – Composite transformations – Three dimensional transformations - Windowing – Viewing – Clipping . Hidden surface removals .

Three dimensional object representations – Three dimensional display methods – parallel and perspective projection – polygon surfaces – Curved lines and surfaces – Cubic spline interpolation – Bezier Curves – B- Spline – Beta spline – Constructive Solid Geometry.

Light – Color – Shading – Transparency- Shadows – Ray tracing – Halftones – Color tables.

References:

1. "Computer Graphics – A Programming Approach" , Steven Harrington , McGraw Hill Publications .
2. "Computer Graphics" , Donald Hearn & M . Pauline Baker – PHI Edition

Note: 20% choice may be given while setting the question paper.

**MTE 2009:INDUSTRIAL HYDRAULICS 3-0-0-3**

Introduction to hydraulic/pneumatic devices, their applications and characteristics-comparison of electric, hydraulic and pneumatic devices.

Pumps and motors: principles of working, range of displacement and pressures. Fixed and variable discharge pumps, gear pumps, internal gear pump, serotor pump, vane pump/piston pump, axial piston pump, swash plate pump, bent-axis pump. Types of hydraulic motors and their characteristics.

Accessories: Hydraulic accumulators, intensifiers, filters, heater, cooler, tank.

Hydraulic valves: Stop valve, non-return valve, relief valve, sequence valve, counter balance valve, pressure reducing valve, flow control valves, direction control valves, their principles of operations and applications. JIC symbols of hydraulic/pneumatic components.

Properties of commonly used hydraulic fluids.

Typical hydraulic circuits: Examples of practical circuits like those used in machine tools, riveter, pneumatic hammer, hydraulic pressure, power steering.

Design of hydraulic/pneumatic equipment/circuit to fulfill a given set of requirements like a sequence of operations, load conditions, speed of operation etc. Specifying the components and their rating. Drawing the circuit using standard symbols.

Fluidics: Introduction to fluidic devices, principle of working of common fluidic devices like wall attachment devices, proportional amplifiers, turbulent amplifiers, fluidic logic devices.

Examples of applications of fluidic devices like edge control of steel plate in rolling mills, tension control.

Reference:

1. Pippenger , John J & Koff Richard M: Fluid Power Controls
2. Pippenger , John J & Hicks,Tyler G: Industrial Hydraulics
3. Kirshner, Joseph M: Fluid Amplifiers
4. Kirshner, Joseph M & Silas Katz: Design Theory of Fluidic components
5. Dr. Heinz Zoebl, Techn: Fundamentals of Hydraulic circuitry

**Note: 20% choice may be given while setting the question paper.**

## MCC 3101 Research Methodology

Introduction – Meaning of research – Objectives of research – Motivation in research – Types of research – Research approaches – Significance of research – Research methods vs Methodology – Criteria of good research.

Defining Research Problem – What is a research problem – Selecting the problem – Necessity of defining the problem – Literature review – Importance of literature review in defining a problem – Critical literature review – Identifying gap areas from literature review

Research design – Meaning of research design – Need– Features of good design – Important concepts relating to research design – Different types – Developing a research plan

Method of data collection – Collection of data- observation method – Interview method –Questionnaire method – Processing and analysis of data – Processing options – Types of analysis – Interpretation of results

Report writing – Types of report – Research Report, Research proposal ,Technical paper – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Simple exercises – Oral presentation – Planning – Preparation – Practice – Making presentation – Answering questions - Use of visual aids – Quality & Proper usage – Importance of effective communication - Illustration

**References**

Coley S M and Scheinberg C A, 1990, "Proposal Writing", Newbury Sage Publications.

Leedy P D, "Practical Research : Planning and Design", 4th Edition, N W MacMillan Publishing Co.

Day R A, *"How to Write and Publish a Scientific Paper"*, Cambridge University Press, 1989.