**AFFILIATED INSTITUTIONS**

**ANNA UNIVERSITY, CHENNAI**

# REGULATIONS - 2009

## M.E. COMPUTER AIDED DESIGN

## II TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

### SEMESTER II

| SL. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | ED 9221 | Finite Element Methods in Mechanical Design | 3 | 1 | 0 | 4 |
| 2 | ED 9222 | Vibration Analysis and Control * | 3 | 0 | 2 | 4 |
| 3 | **CD 9221** | Integrated Mechanical Design* | **3** | **1** | **0** | **4** |
| 4 | CD 9222 | Computer Aided Tools | 3 | 0 | 0 | 3 |
| 5 | E3 | Elective III | 3 | 0 | 0 | 3 |
| 6 | E4 | Elective IV | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7 | ED 9225 | Analysis and Simulation Lab | 0 | 0 | 2 | 1 |
| 8 | CD 9223 | Seminar | 0 | 0 | 2 | 1 |
| | | **TOTAL** | **18** | **1** | **6** | **23** |

### SEMESTER III

| SL. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | E5 | Elective V | 3 | 0 | 0 | 3 |
| 2 | E6 | Elective VI | 3 | 0 | 0 | 3 |
| 3 | E7 | Elective VII | 3 | 0 | 0 | 3 |
| 4 | CD 9231 | Project Work (Phase I) | 0 | 0 | 12 | 6 |
| | | **TOTAL** | **9** | **0** | **12** | **15** |

### SEMESTER IV

| SL. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | CD 9241 | Project Work (Phase II) | 0 | 0 | 24 | 12 |
| | | **TOTAL** | **0** | **0** | **24** | **12** |

* A Term Project must be given for Assessment – 3 (Compulsory)

**TOTAL NUMBER OF CREDITS: 21+23 + 15 + 12 = 71**

## LIST OF ELECTIVES FOR M.E. COMPUTER AIDED DESIGN

| COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| CC 9222 | Integrated Manufacturing Systems | 3 | 0 | 0 | 3 |
| CC 9221 | Design for Manufacture, Assembly & Environments | 3 | 0 | 0 | 3 |
| **CD 9268** | Mini Project | 3 | 0 | 0 | 3 |
| CI 9222 | Mechatronics in Manufacturing | 3 | 0 | 0 | 3 |
| ED 9250 | Optimization Techniques in Design | 3 | 0 | 0 | 3 |
| ED 9251 | Engineering Fracture Mechanics | 3 | 0 | 0 | 3 |
| ED 9252 | Tribology in Design | 3 | 0 | 0 | 3 |
| ED 9253 | Advanced Mechanics of Materials | 3 | 0 | 0 | 3 |
| ED 9254 | Composite Materials and Mechanics | 3 | 0 | 0 | 3 |
| ED 9255 | Applied Engineering Acoustics | 3 | 0 | 0 | 3 |
| ED 9256 | Advanced Tool Design | 3 | 0 | 0 | 3 |
| ED 9257 | Productivity Management and Re-Engineering | 3 | 0 | 0 | 3 |
| ED 9258 | Industrial Robotics and Expert systems | 3 | 0 | 0 | 3 |
| ED 9259 | Design of Material Handling Equipments | 3 | 0 | 0 | 3 |
| ED 9260 | Plasticity and Metal Forming | 3 | 0 | 0 | 3 |
| **ED 9261** | **Theory of Plates and Shells** | **3** | **0** | **0** | **3** |
| ED 9262 | Design of Pressure Vessels and Piping | 3 | 0 | 0 | 3 |
| ED 9263 | Modal Analysis of Mechanical Systems | 3 | 0 | 0 | 3 |
| **ED 9264** | **Design of Hydraulic and Pneumatic systems** | **3** | **0** | **0** | **3** |
| ED 9265 | Experimental Stress Analysis | 3 | 0 | 0 | 3 |
| ED 9266 | Maintenance Engineering | 3 | 0 | 0 | 3 |
| ED 9267 | Bearing Design and Rotor Dynamics | 3 | 0 | 0 | 3 |
| ED 9271 | Rapid Prototyping and Tooling | 3 | 0 | 0 | 3 |
| EY 9256 | Design of Heat Exchangers | 3 | 0 | 0 | 3 |
| IC 9262 | Computational Fluid Dynamics | 3 | 0 | 0 | 3 |
| **IE 9224** | Supply Chain Management | 3 | 0 | 0 | 3 |
| PD 9250 | Design Paradigm | 3 | 0 | 0 | 3 |
| PD 9251 | Micro Electro Mechanical Systems | 3 | 0 | 0 | 3 |
| PD 9252 | Creativity in Design | 3 | 0 | 0 | 3 |
| PD 9253 | Reverse Engineering | 3 | 0 | 0 | 3 |
| PD 9254 | Enterprise Resource Planning | 3 | 0 | 0 | 3 |

**ED9221 FINITE ELEMENT METHODS IN MECHANICAL DESIGN (Common for M.E Degree Programs in Engineering Design, CAD & PDD streams)** **L T P C 3 1 0 4**

**OBJECTIVE:**

At the end of this course the students would have developed a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in engineering design

**UNIT I GENERAL INTRODUCTION * 10**

Introduction- structural element and system- assembly and analysis of a structure- boundary conditions- general pattern- standard discrete system- transformation of coordinates- examples – direct physical approach to problems in elasticity- direct formulation- displacement approach – minimization of total potential- convergence criteria – discretization error- nonconforming elements and patch test- solution process- numerical examples

**UNIT II GENERALIZATION OF FINITE ELEMENT CONCEPTS AND ELEMENT SHAPE FUNCTIONS* 7**

Boundary value problems – integral or weak statements- weighted residual methods- Galerkin method- virtual work as weak form of equations in solid and fluid mechanics- variational principles – establishment of natural variational principles for linear self-adjoint differential equations –standard and hierarchical elements- shape functions- rectangular elements- completeness of polynomials- Lagrange family- Serendipity family- rectangular prisms- tetrahedral elements- global and local finite element approximation- mapped elements- coordinate transformations- geometrical conformity of elements- evaluation of element matrices- transformation in $\xi, \eta \, and \, \zeta -$ coordinates-order of convergence- numerical integration –example problems

**UNIT III APPLICATIONS TO FIELD PROBLEMS * 9**

Solution to problems in linear elasticity- plane problems in elasticity- plates and shells- solution of problems in heat-transfer and fluid mechanics- numerical examples- discussion on error estimates

**UNIT IV FINITE ELEMENTS IN STRUCTURAL DYNAMICS AND VIBRATIONS ** 10**

Dynamic equations- stiffness, mass and damping matrices- consistent and diagonal mass matrices- Extraction of natural frequencies and modes- Reduction of number of degrees of freedom - modal methods - component mode synthesis- harmonic analysis- response history- explicit and implicit direct integration- stability and accuracy- analysis of response spectra- example problems

**UNIT V NON-LINEAR ANALYSIS *** 9**

Non-linear problems in elasticity- some solution methods- plasticity: introduction, general formulation for small strains- formulation for von Mises theory- computational procedure- problems of gaps and contact- geometric non-linearity- modelling considerations

**TOTAL : 60 PERIODS**

**Note**

At the post-graduate level of instruction the contact hours are to be supplemented by self study by students. As for the examination, modelling considerations, choice of elements, boundary conditions, loading conditions, and basic procedures only need to be emphasized without expecting a complete numerical solution to practical problems.

**REFERENCES**


1. *Zienkiewicz.O.C, Taylor.R.L,& Zhu,J.Z "The Finite Element Method: Its Basis & Fundamentals", Butterworth-Heinemann (An imprint of Elsevier), First printed in India 2007, India Reprint ISBN:978-81-312-1118-2, published by Elsevier India Pvt. Ltd., New Delhi.
2. **Cook, R.D., Malkus, D. S., Plesha,M.E., and Witt,R.J " Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 4th Edition, First Reprint 2007, Authorized reprint by Wiley India(P) Ltd., New Delhi, ISBN-13 978-81-265-1336-9
3. *** Zienkiewicz.O.C, Taylor.R.L "The Finite Element Method" McGraw Hill International Editions, Fourth Edition, 1991, Volume 2 (Chapters 7&8)
4. Reddy, J.N., "Introduction to Non-Linear Finite Element Analysis", Oxford Uniiversity Press, 2008
5. Rao,S.S., "The Finite Element Method in Engineering", Butterworth-Heinemann(An imprint of Elsevier), reprinted 2006,2007, Published by Elsevier India Pvt. Ltd., New Delhi, Indian Reprint ISBN: 978-81-8147-885-6
6. Huebner,K.H., Dewhirst,D.L.,Smith,D.E & Byron,T.G., "The Finite Element Method for Engineers", Wiley Student Edition, Fourth Edition 2004,John Wiley&Sons(Asia)Pve.Ltd., ISBN: 9812-53-154-8
7. Ramamurthi, V., "Finite Element Method in Machine Design", Narosa Publishing House, January 2009, ISBN: 978-81-7319-965-3


**ED9222 VIBRATION ANALYSIS AND CONTROL** **L T P C**
**3 0 2 4**

**OBJECTIVE:**

- To understand the Fundamentals of Vibration and its practical applications.
- To understand the working principle and operations of various vibrations
- Measuring instruments
- To understand the various Vibration control strategies

**UNIT I FUNDAMENTALS OF VIBRATION 10**

Introduction -Sources Of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers -.Response To Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads-Critical Speed Of Shaft-Rotor systems.

**UNIT II TWO DEGREE FREEDOM SYSTEM 7**

Introduction-Free Vibration Of Undamped And Damped- Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates

**UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 9**

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients-Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method - Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

**UNIT IV VIBRATION CONTROL 9**

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

**UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 10**

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes

**45 + 15 Lab TOTAL : 60 PERIODS**

**** a Term Project must be given for Assessment – 3 (Compulsory)**

**TEXT BOOKS:**

1. Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.
2. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990

**REFERENCES:**

1. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.
2. S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw – Hill Publishing Com. Ltd New Delhi,2007.

**CD9221 INTEGRATED MECHANICAL DESIGN** L T P C**
**(Use of Approved Data Book Is Permitted) 3 1 0 4**

**UNIT I FUNDAMENTALS AND DESIGN OF SHAFTS 8**

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration –BIS, ISO, DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress - Theories of Failure – Ductile vs. brittle component design.

**UNIT II DESIGN OF SHAFT AND BEARING 8**

Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity.

**UNIT III DESIGN OF GEARS AND GEAR BOXES 12**

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Design for sub assembly – Integrated design of speed reducers and multi-speed gear boxes – application of software packages.

**UNIT IV BRAKES 7**

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

**UNIT V INTEGRATED DESIGN 18**

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools

**TOTAL: 45+15= 60 PERIODS**

**The Pattern of Question Paper will consist one Question from Unit – 4 for 50% of total marks.**

** **a Term Project must be given for Assessment – 3 (Compulsory)**

**REFERENCES:**


1. Norton L. R., "Machine Design – An Integrated Approach" Pearson Education, 2005
2. Newcomb, T.P. and Spur, R.T., "Automobile Brakes and Braking Systems", Chapman and Hall, 2nd Edition, 1975.
3. Maitra G.M., "Hand Book of Gear Design", Tata McGraw Hill, 1985.
4. Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, 1986.
5. Prasad. L. V., "Machine Design", Tata McGraw Hill, New Delhi, 1992.
6. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
7. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.


**TEXT BOOKS**


1. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & Suma Publishers, Bangalore, 1983


**CD9222 COMPUTER AIDED TOOLS L T P C**
**3 0 0 3**

**UNIT I COMPUTER AIDED MANUFACTURING 9**

Manufacturing Processes – Removing, Forming, Deforming and joining – Integration Requirements. Integrating CAD, NC and CAM – Machine tools – Point to point and continuous path machining, NC, CNC and DNC – NC Programming – Basics, Languages, G Code, M Code, APT – Tool path generation and verification – CAD/CAM NC Programming – Production Control – Cellular Manufacturing

**UNIT II COMPUTER AIDED PROCESS PLANNING 9**

Role of process planning in CAD/CAM Integration – Computer Aided Process Planning – Development, Benefits, Model and Architecture – CAPP Approaches – Variant, Generative and Hybrid – Process and Planning systems – CAM-I, D-CLASS and CMPP – Criteria in selecting a CAPP System.

**UNIT III COMPUTER AIDED INSPECTION 9**

Engineering Tolerances – Need for Tolerances – Conventional Tolerances – FITS and LIMITS – Tolerance Accumulation and Surface quality – Geometric Tolerances – Tolerances Practices in design, Drafting and manufacturing – Tolerance Analysis – Tolerance synthesis – Computer Aided Quality control – Contact Inspection Methods – Non Contact Inspection Methods - Non optical.

**UNIT IV REVERSE ENGINEERING 9**

Scope and tasks of Reverse Engineering – Domain Analysis – Process Duplicating – Tools for RE – Developing Technical data – Digitizing techniques – Construction of surface model – Solid part model – Characteristic evaluation – Software's and its application – CMM and its feature capturing – surface and solid modeling.

**UNIT V DATA MANAGEMENT 9**

Strategies for Reverse Engineering Data management – Software application – Finding renewable software components – Recycling real time embedded software – Design experiments to evaluate a RE tools – Rule based detection for RE user interface – RE of assembly programs

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
2. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994


**REFERENCES**


1. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata Mc Graw Hill Publication, 2007
2. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design and manufacturing", Mc Graw Hill International series, 1991
3. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996
4. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American Gear Manufacturers Association.


**ED9225 ANALYSIS AND SIMULATION LAB L T P C**
**0 0 2 1**

Analysis of Mechanical Components – Use of FEA Packages like ANSYS/ NASTRAN etc., Exercises shall include analysis of

i) Machine elements under Static loads
ii) Thermal Analysis of mechanical systems
iii) Modal Analysis
iv) Machine elements under Dynamic loads
v) Non-linear systems

Use of kinematics and dynamics simulation software like ADAMS, MATLAB. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

**TOTAL : 30 PERIODS**

**CC 9222 INTEGRATED MANUFACTURING SYSTEMS L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 5**

Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations.

**UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 5**

Introduction-part families-parts classification and cooling - group technology machine cells-benefits of group technology. Process planning function CAPP - Computer generated time standards.

**UNIT III COMPUTER AIDED PLANNING AND CONTROL 10**

Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.

**UNIT IV COMPUTER MONITORING 10**

Types of production monitoring systems-structure model of manufacturing process-process control & strategies- direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

**UNIT V INTEGRATED MANUFACTURING SYSTEM 15**

Definition - application - features - types of manufacturing systems-machine tools-materials handling system- computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.

**REFERENCES:**

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.

| CC9221 | DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS | L T P C 3 0 0 3 |
|---|---|---|

**UNIT I INTRODUCTION 5**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

**UNIT II FACTORS INFLUENCING FORM DESIGN 13**

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

**UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 8**

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

**UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION 10**

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

**UNIT V DESIGN FOR THE ENVIRONMENT 9**

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
5. Fixel, J. Design for the Environment McGraw hill., 1996.
6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
7. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004.

**CI 9222 MECHATRONICS IN MANUFACTURING L T P C**
**3 0 0 3**

**OBJECTIVE**

This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

**UNIT I INTRODUCTION 5**

Introduction to Mechatronics - Systems- Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics - Measurement Systems - Control Systems.

**UNIT II SENSORS AND TRANSDUCERS 12**

Introduction - Performance Terminology – Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors - Selection of sensors - Signal processing.

**UNIT III ACTUATORS 12**

Actuators – Mechanical - Electrical - Fluid Power - Piezoelectric - Magnetostrictive - Shape memory alloy - applications - selection of actuators.

**UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 8**

Introduction - Basic structure - Input and output processing - Programming - Mnemonics- Timers, counters and internal relays - Data handling - Selection of PLC.

**UNIT V DESIGN AND MECHATRONICS CASE STUDIES 8**

Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine - Engine Management system - Automatic car park barrier - Data acquisition Case studies.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Bolton.W, “Mechatronics” , Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines",Oxford university press, 2008


**REFERENCES:**


1. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007.
2. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.
3. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applicatlions” Tata McGraw-Hill Publishing company Limited, 2003.
4. Michael B.Histand and Davis G.Alciatore,” Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition, 1999.
5. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Nelson Thornes ltd, Eswar press, Indian print, 2004.
6. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics”, Prentice Hall of India Pvt Ltd, 2000.
7. Dan Necsulescu, “Mechatronics”, Pearson education, 2002.
8. Newton C.Braga, “Mechatronics Sourcebook”, Thomson Delmar Learning, Eswar Press, 2003.

**ED9250 OPTIMIZATION TECHNIQUES IN DESIGN L T P C**
**3 0 0 3**

**UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES 10**

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

**UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES 10**

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming

**UNIT III ADVANCED OPTIMIZATION TECHNIQUES 10**

Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques; Neural network & Fuzzy logic principles in optimization.

**UNIT IV STATIC APPLICATIONS 8**

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

**UNIT V DYNAMIC APPLICATIONS 7**

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2000.
2. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.
3. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.
4. Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, 1989.


**ED9251 ENGINEERING FRACTURE MECHANICS L T P C**
**3 0 0 3**

**UNIT I ELEMENTS OF SOLID MECHANICS 9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy’s function – field equation for stress intensity factor.

**UNIT II STATIONARY CRACK UNDER STATIC LOADING 9**

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin’s approximation - plastic zone size – Dugdaale model – determination of integral and its relation to crack opening displacement.

**UNIT III ENERGY BALANCE AND CRACK GROWTH 9**

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

**UNIT IV FATIGUE CRACK GROWTH CURVE 9**

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

**UNIT V APPLICATIONS OF FRACTURE MECHANICS 9**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

**TOTAL :45 PERIODS**

**REFERENCES:**


1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 1978.
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
4. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1977


**ED9252 TRIBOLOGY IN DESIGN L T P C**
**3 0 0 3**

**UNIT I SURFACE INTERACTION AND FRICTION 7**

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

**UNIT II WEAR AND SURFACE TREATMENT 8**

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements – Laser methods – instrumentation - International standards in friction and wear measurements

**UNIT III LUBRICANTS AND LUBRICATION REGIMES 8**

Lubricants and their physical properties- Viscosity and other properties of oils – Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

**UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION 12**

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

**UNIT V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION 10**

Rolling contacts of Elastic solids**-** contact stresses – Hertzian stress equation-Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
4. Williams J.A. “ Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005
6. G.W.Stachowiak & A.W .Batchelor , Engineering Tribology, Butterworth-Heinemann, UK, 2005


**ED9253 ADVANCED MECHANICS OF MATERIALS L T P C**
**3 0 0 3**

**UNIT I ELASTICITY 9**

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress - Airy's stress function. Energy methods.

**UNIT II SHEAR CENTER AND UNSYMMETRICAL BENDING 10**

Location of shear center for various thin sections - shear flows. Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.

**UNIT III CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES 10**

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions

**UNIT IV TORSION OF NON-CIRCULAR SECTIONS 7**

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

**UNIT V STRESSES IN ROTARY SECTIONS AND CONTACT STRESSES 9**

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. P Boresi, Richard J. Schmidt, “Advanced mechanics of materials”, John Wiley, 2002.
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
3. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985.
4. Srinath. L.S., “Advanced Mechanics of solids”, Tata McGraw Hill, 1992.
5. G H Ryder Strength of Materials Macmillan, India Ltd, 2007.


**ED9254 COMPOSITE MATERIALS AND MECHANICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the fundamentals of composite material strength and its mechanical behavior
- Understanding the analysis of fiber reinforced Laminate design for different Combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

**UNIT I LAMINA CONSTITUTIVE RELATIONS 12**

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke’s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix ($Q_{ij}$), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.

**UNIT II FLAT PLATE LAMINATE CONSTITUTIVE RELATIONS 10**

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

**UNIT III LAMINA STRENGTH ANALYSIS 5**

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

**UNIT IV ANALYSIS OF LAMINATED FLAT PLATES 10**

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

**UNIT V EFFECT OF THERMAL PROPERTIES 8**

Modification of Hooke's Law due to thermal properties - Modification of Laminate Constitutive Equations. Orthotropic Lamina - special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates - Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998


**REFERENCES:**


1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.
6. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)


**ED9255 APPLIED ENGINEERING ACOUSTICS L T P C**
**3 0 0 3**

**UNIT I BASIC CONCEPTS OF ACOUSTICS 9**

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power – Wave motion – Alteration of wave paths –Measurement of sound waves – sound spectra – Sound fields – Interference – Standing waves – Acoustic energy density and intensity – Specific acoustic impedance.

**UNIT II CHARACTERISTICS OF SOUND 10**

One dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

**UNIT III TRANSMISSION PHENOMENA 6**

Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

**UNIT IV INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND 10**

Introduction – Decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness – Loudness, Loudness level, perceived noise, perceived noise level – Equivalent sound level – Identified level – Frequency and Amplitude measurement.

**UNIT V BASICS OF NOISE CONTROL 10**

Noise Control at source, path, receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Lawrence E. Kinsler, Austin R. Frey, “Fundamentals of Acoustics “– John Wiley and Sons Inc., 1986.
2. Bies, David, A. and Hansen, Colin H., “Engineering Noise Control – Theory and Practice”, E and FN Spon, Chapman-Hall, Second Edition, 1996.
3. Hansen C.H. and Snyder, S.D., “Active Control of Sound and Vibration”, E and FN Spon, London 1996.


**ED9256 ADVANCED TOOL DESIGN L T P C**

**3 0 0 3**

**UNIT I INTRODUCTION TO TOOL DESIGN 8**

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design- Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment

**UNIT II DESIGN OF CUTTING TOOLS 9**

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters

**UNIT III DESIGN OF JIGS AND FIXTURES 10**

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

**UNIT IV DESIGN OF PRESS TOOL DIES 10**

Types of Dies –Method of Die operation–Clearance and cutting force calculations-Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.

**UNIT V TOOL DESIGN FOR CNC MACHINE TOOLS 8**

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman,” Jig and Fixture Design”, Thomson Asia Pvt Ltd, Singapore, 2004
3. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000
4. Venkataraman K., “Design of Jigs, Fixtures and Presstools”, TMH, 2005
5. Haslehurst M., “Manufacturing Technology”, The ELBS, 1978


**ED9257 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING L T P C**
**3 0 0 3**

**UNIT I PRODUCTIVITY 9**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models

**UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 9**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

**UNIT III ORGANISATIONAL TRANSFORMATION 9**

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

**UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 9**

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

**UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION 9**

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

**TOTAL: 45 PERIODS**

**REFERENCES:**
1. Sumanth, D.J., 'Productivity Engineering and Management', TMH, New Delhi, 1990.
2. Edosomwan, J.A., "Organisational Transformation and Process Re-engineering", Library Cataloging in Pub. Data, 1996.
3. Rastogi, P.N., "Re-engineering and Re-inventing the Enterprise", Wheeler Pub. New Delhi, 1995.
4. Premvrat, Sardana, G.D. and Sahay, B.S., "Productivity Management – A Systems Approach", Narosa Publishing House. New Delhi, 1998.

**ED9258 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION AND ROBOT KINEMATICS 10**

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.

Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

**UNIT II ROBOT DRIVES AND CONTROL 9**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

**UNIT III ROBOT SENSORS 9**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing – Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

**UNIT IV ROBOT CELL DESIGN AND APPLICATION 9**

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

**UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 8**

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.

**REFERENCES:**


1. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
2. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
6. Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer –Verlag, New York, May 1991.


**ED9259 DESIGN OF MATERIAL HANDLING EQUIPMENTS L T P C**
**(Use of Approved Data Book Is Permitted) 3 0 0 3**

**UNIT I MATERIALS HANDLING EQUIPMENT 5**

Types, selection and applications

**UNIT II DESIGN OF HOISTS 10**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

**UNIT III DRIVES OF HOISTING GEAR 10**

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

**UNIT IV CONVEYORS 10**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

**UNIT V ELEVATORS 10**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

**TOTAL :45 PERIODS**

**TEXT BOOKS**


1. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985


**REFERENCES**


1. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.
3. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.
4. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol.1 & 2, Suma Publishers, Bangalore, 1983

**ED9260 PLASTICITY AND METAL FORMING L T P C**
**3 0 0 3**

**UNIT I THEORY OF PLASTICITY 9**

Theory of plastic deformation - Engineering stress and strain relationship – Stress tensor - Strain tensor - Yield criteria's - Plastic stress strain relationship – Plastic work - Equilibrium conditions - Incremental plastic strain

**UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY 7**

Uniaxial tension test - Mechanical properties - Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

**UNIT III ANALYSIS OF METAL FORMING PROBLEMS 12**

Slab analysis - Slip line method, upper bound solutions, statistically admissible stress field, numerical methods, contact problems, effect of friction, thermo elastic Elasto plasticity, elasto visco plasticity - Thermo mechanical coupling – Analysis of forging, rolling, extrusion and wire drawing processes - Experimental techniques of the evaluation of metal forming

**UNIT IV ANALYSIS OF SHEET METAL FORMING 8**

Bending theory - Cold rolling theory - Hill's anisotropic theory, Hill's general yield theory - Sheet metal forming - Elements used - Mesh generation and formulation - Equilibrium equations - Consistent full set algorithm - Numerical solutions procedures - examples of simulation of simple parts - Bench mark tests – Forming limit diagrams

**UNIT V ADVANCES IN METAL FORMING 9**

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotropic pressing, high speed extrusion, rubber pad forming, micro blanking –Superplastic forming - Overview of Powder Metal techniques - Powder rolling - Tooling and process parameters

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Wagoner. R H., and Chenot. J.J., Metal Forming analysis,Cambridge University Press, 2002.
2. Slater. R A. C., Engineering Plasticity - Theory & Applications to Metal Forming, John Wiely and Sons, 1987.
3. Shiro Kobayashi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Narayanaswamy. R, Theory of Metal Forming Plasticity, Narosa Publishers, 1999.
5. Hosford. W. F and Caddell. RM., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 1993.
6. Surender Kumar, " Technology of Metal Forming Processes", Prentice Hall of India, New Delhi, 2008

**ED9261 THEORY OF PLATES AND SHELLS LT P C**
**3 0 0 3**

**OBJECTIVE:**

After undergoing this course, the students would be in a position to understand the behaviour of these commonly occurring structural elements in engineering design and would have developed the capability to design and analyse them in their normal design practice.

**UNIT I GENERAL INTRODUCTION 7**

Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variational methods in elasticity- virtual work-external and internal virtual work- variational operator- functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications

**UNIT II CLASSICAL THEORY OF PLATES 10**

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

**UNIT III BUCKLING ANALYSIS OF RECTANGULAR PLATES 10**

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

**UNIT IV VIBRATION OF PLATES 9**

Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported- Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method- Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

**UNIT V ANALYSIS OF THIN ELASTIC SHELLS OF REVOLUTION 9**

Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells- analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads- shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Reddy,J.N., "Theory and Analysis of Elastic Plates & Shells", C.R.C.Press,NY,USA, 2nd Edition
2. Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc., 1995
3. Timoshenko, S. and Krieger S.W. Theory of Plates and Shells, McGraw Hill Book Company, New York 1990.
4. Wilhelm Flügge, stresses in shells, Springer - Verlag
5. Timoshenko, S. Theory of Plates and Shells, McGraw Hill, 1990
6. Ramasamy, G.S., Design and Construction of Concrete Shells Roofs, CBS Publishers, 1986
7. Dr.N.Subramanian, Principles of Space Structures , Wheeler Publishing Co. 1999


**ED9262 DESIGN OF PRESSURE VESSELS AND PIPING L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 3**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

**UNIT II STRESSES IN PRESSURE VESSELS 15**

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

**UNIT III DESIGN OF VESSELS 15**

Design of Tall cylindrical self supporting process columns – supports for short vertical vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design.

**UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 8**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

**UNIT V PIPING 4**

Introduction – Flow diagram – piping layout and piping stress Analysis.

**TOTAL: 45 PERIODS**

**TEXT BOOK**


1. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 1987.


**REFERENCES**


1. Henry H. Bedner, "Pressure Vessels, Design Hand Book, CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design. Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.

**ED9263 MODAL ANALYSIS OF MECHANICAL SYSTEMS L T P C**
**3 0 0 3**

**UNIT I OVERVIEW 6**

Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure.

**UNIT II THEORETICAL BASIS 12**

Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Non-sinusoidal vibration and FRF Properties – Analysis of Weakly Nonlinear Structures.

**UNIT III MOBILITY MEASUREMENT TECHNIQUES 10**

Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Measurement on Non linear structures – Multi point excitation methods.

**UNIT IV MODAL PARAMETER EXTRACTION METHODS 11**

Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

**UNIT V DERIVATION OF MATHEMATICAL MODELS 6**

Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Ewins D J, “Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1988
2. Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”, Wiley John & sons, 1997.


**ED9264 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS L T P C**
**3 0 0 3**

**UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 5**

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

**UNIT II CONTROL AND REGULATION ELEMENTS 12**

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

**UNIT III HYDRAULIC CIRCUITS 5**

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

**UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 16**

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

**UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7**

Pneumatic equipments- selection of components - design calculations – application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, "Basic fluid power", Prentice Hall, 1987.
3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 1999.
4. Bolton. W., "Pneumatic and Hydraulic Systems ", Butterworth –Heinemann, 1997.
5. K.Shanmuga Sundaram, "Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)


**ED9265 EXPERIMENTAL STRESS ANALYSIS L T P C**
**3 0 0 3**

**UNIT I FORCES AND STRAIN MEASUREMENT 9**

Strain gauge, principle, types, performance and uses. Photo elasticity – Principle and applications - Moire Fringe - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines.

**UNIT II VIBRATION MEASUREMENTS 9**

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

**UNIT III ACOUSTICS AND WIND FLOW MEASURES 9**

Principles of Pressure and flow measurements – pressure transducers – sound level meter – venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis

**UNIT IV DISTRESS MEASUREMENTS 9**

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition.

**UNIT V NON DESTRUCTIVE TESTING METHODS 9**

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Sadhu Singh – Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
2. JW Dalley and WF Riley, Experimental Stress Analysis, McGraw Hill Book Company, N.Y. 1991
3. L.S.Srinath et al, Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1984
4. R.S.Sirohi, HC Radhakrishna, Mechanical Measurements, New Age International (P) Ltd. 1997
5. F.K Garas, J.L. Clarke and GST Armer, Structural assessment, Butterworths, London, 1987
6. D.E. Bray & R. K.Stanley, Non-destructive Evaluation, McGraw Hill Publishing Company, N.Y.1989


**ED 9266 MAINTENANCE ENGINEERING L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION TO MAINTENANCE SYSTEMS 8**

Introduction to repair and Maintenance -Maintenance as business - Maintenance systems such as reactive, preventive, predictive or proactive systems - Human resources management in Maintenance management -maintainability- Inherent and overall availability. - Mean time between failures, mean time to repairs and mean down time - Testability and supportability - “Design for Maintenance” - Poor maintainability aspects - Design for reliability.

**UNIT II CONDITION BASED MAINTENANCE 7**

Condition based monitoring of equipment and systems -condition monitoring techniques such as a) Vibration analysis, b) Ultrasonic detection techniques, c) Thermography, d) Oil and lubricant analysis, e) Motor condition monitoring (MCM) - Shaft alignments through laser - Vibration instruments -Outline on Thermography

**UNIT III MAINTENANCE TECHNIQUES SUCH AS RELIABILITY CENTRED MAINTENANCE (RCM), TOTAL PRODUCTIVE MAINTENANCE (TPM) & CMMS 10**

Reliability centred Maintenance-Failure Mode and Effect Analysis-Root cause Analysis- logic tree analysis-Criticality matrix - Total Productive Maintenance, Overall Equipment Effectiveness-Lean manufacturing- TPM and TPO- Relationship between OEE and world-class Maintenance- Ladder of Maintenance improvement- Computerized Maintenance management system in a business scenario- data acquisition for effective management of CMMS.

**UNIT IV ASSET PLANNING AND SCHEDULING OF ACTIVITIES IN MAINTENANCE 10**

Asset and spare part management, - Conventional spare Parts management techniques such as Economic Order Quantity, two bin systems - Latest trends in monitoring through bar codes, mobile computer and wireless data transmissions -. Different aspects of planning and scheduling of Maintenance, such as shutdowns- Critical aspects of both routine and shut down Maintenance -. bar charts - PERT network during shut down -Man power Training and utilization of skilled manpower - Sequencing of activities.

**UNIT V SAFETY AND OTHER ASPECTS OF MAINTENANCE FUNCTIONS 10**

Safety Engineering. - Hazard analysis -General rules and guidelines in safety and hazard prevention - Analytical tools - Hazard analysis- Fault Tree Analysis - Sneak Circuit analysis - Integrated approach to Maintenance- Statistical distributions such as normal, gamma and "Weibull" in Maintenance- Maintenance effectiveness.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. "Maintenance Engineering and Management": K.Venkataraman-PHI Learning-2007

**REFERENCES:**

1. Kelly. A and Harris, M. J, "Management of Industrial maintenance", Butter worth & Co., 1978
2. David J. Smith, "Reliability and Maintainability in Perspective", McMillan,2nd Edition, 1985.
3. Gwidon W Stachowiak and Andrew W. Batchelor, "Engineering Tribology", Butterwork-Heinmann, 2001
4. John V.Grimaldi & Rollin H.Simonds, "Safety Management", AITBS Publishers & Distributors, 2001.

**ED 9267 BEARING DESIGN AND ROTOR DYNAMICS L T P C**
**3 0 0 3**

**UNIT I CLASSIFICATION AND SELECTION OF BEARINGS 6**

Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings- Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision Applications-Foil Bearings-Special bearings-Selection of plain Bearing materials –Metallic and Non metallic bearings

**UNIT II DESIGN OF FLUID FILM BEARINGS 10**

Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations-Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings- Stiffness consideration - flow regulators and pump design

**UNIT III SELECTION AND DESIGN OF ROLLING BEARINGS 10**

Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication- Fatique life calculations- Bearing operating temperature- Lubrication- Selection of lubricants- Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings- Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection

**UNIT IV DYNAMICS OF HYDRODYNAMIC BEARINGS 10**

Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions

**UNIT V ROTOR DYNAMICS 9**

Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
4. Williams J.A. “ Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice – Hall of India Pvt Ltd , New Delhi, 2005
6. G.W.Stachowiak & A.W .Batchelor , Engineering Tribology, Butterworth-Heinemann, UK, 2005


**ED 9271 RAPID PROTOTYPING AND TOOLING L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 7**

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

**UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10**

Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

**UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS: 10**

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

**UNIT IV REVERSE ENGINEERING AND CAD MODELING 10**

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

**UNIT V RAPID TOOLING 8**

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

**REFERENCES:**

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006

**EY9256 DESIGN OF HEAT EXCHANGERS L T P C**
**3 0 0 3**

**AIM:**

The course is intended to build up necessary background for the design of the various types of heat exchangers.

**OBJECTIVE:**

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

**UNIT I FUNDAMENTALS OF HEAT EXCHANGER 9**

Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.

**UNIT II FLOW AND STRESS ANALYSIS 9**

Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses, types of failures.

**UNIT III DESIGN ASPECTS 9**

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe, finned tube, shell and tube heat exchangers, simulation of heat exchangers.

**UNIT IV COMPACT AND PLATE HEAT EXCHANGERS 9**

Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters, limitations.

**UNIT V CONDENSERS & COOLING TOWERS 9**

Design of surface and evaporative condensers – cooling tower – performance characteristics.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Sadik Kakac, Hongtan Liu,Heat Exchangers Selection, Rating and Thermal Design,CRC Press,2002.

**REFERENCES:**

1. P Arthur. Frass, Heat Exchanger Design, John Wiley & Sons, 1988.
2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co. 1980.
3. Hewitt.G.F, Shires.G.L, Bott.T.R, Process Heat Transfer, CRC Press, 1994.

**IC9262 COMPUTATIONAL FLUID DYNAMICS L T P C**
**3 0 0 3**

**AIM**

This course aims to introduce numerical modeling and its role in the field of heat and fluid flow, it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.

**OBJECTIVE :**

- To develop finite difference and finite volume discretized forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

**UNIT I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 10**

Classification, Initial and Boundary conditions – Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

**UNIT II CONDUCTION HEAT TRANSFER 10**

Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

**UNIT III INCOMPRESSIBLE FLUID FLOW 10**

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, finite difference approach.

**UNIT IV CONVECTION HEAT TRANSFER AND FEM 10**

Steady One-Dimensional and Two-Dimensional Convection – diffusion, Unsteady one-dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM.

**UNIT V TURBULENCE MODELS 5**

Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
2. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
4. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier-Stokes Equation", Pineridge Press Limited, U.K., 1981.
5. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, New York, USA,1984.
6. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer – Verlag, 1987.
7. Fletcher, C.A.J. "Computational Techniques for fluid Dynamics 2" Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.
8. Bose, T.X., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.


**IE9224 SUPPLY CHAIN MANAGEMENT L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 5**

Logistics- concepts, definitions, approaches, factors affecting logistics. Supply chain - basic tasks of the supply chain - the new corporate model.

**UNIT II SUPPLY CHAIN MANAGEMENT 10**

The new paradigm, the modular company, the network relations, supply process, procurement process - Distribution management.

**UNIT III EVOLUTION OF SUPPLY CHAIN MODELS 10**

Strategy and structure - factors of supply chain - Manufacturing strategy stages, supply chain progress - model for competing through supply chain management - PLC grid, supply chain redesign - Linking supply chain with customer.

**UNIT IV SUPPLY CHAIN ACTIVITY SYSTEMS 10**

Structuring the SC, SC and new products, functional roles in SC, SC design framework., collaborative product commerce(CPC)

**UNIT V SCM ORGANISATION AND INFORMATION SYSTEM 10**

The management task, logistics organisation, the logistics information systems-topology of SC application- MRP, ERP, Warehouse management system, product data management- cases.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Scharj, P.B., Lasen, T.S., Managing the global supply chain, Viva Books, New Delhi, 2000.
2. Ayers, J.B., Hand book of Supply Chain Management, The St. Lencie press,2000.
3. Nicolas, J.N., Competitive manufacturing management- continuous improvement, Lean production, customer focused quality, McGraw-Hill, NY 1998.
4. Steudel, H.J. and Desruelle, P., Manufacturing in the nintees- How to become a mean, lean and world class competitor, Van Nostrand Reinhold, NY, 1992.


**PD9250 DESIGN PARADIGM L T P C**
**3 0 0 3**

**OBJECTIVE**

Study about the design methodologies for manufacture and assembly, value engineering techniques and analysis of product development

**UNIT I DESIGN FOR MANUFACTURE 8**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits – Datum features - Tolerance stacks.

**UNIT II FORM DESIGN OF CASTINGS AND WELDMENTS 9**

Redesign of castings based on parting line considerations - Minimizing core requirements - Redesigning a cast members using weldments-factors influencing form design-Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials-on from design - form design of welded members, forgings and castings.

**UNIT III DESIGN FOR ASSEMBLY 6**

Assembly processes-Handling and insertion process-Manual ,automatic and robotic assembly-Cost of Assembly-Number of Parts-DFA guidelines

**UNIT IV VALUE ENGINEERING 12**

Value –types –functional –operational –aesthetic –cost- –material – Design process – value and worthiness –procedure -brainstorming sessions –evaluation –case studies –value estimation- Value analysis - Design for value - Selection of alternatives - optimization – Implementation

**UNIT V PRODUCT DEVELOPMENT ECONOMICS 10**

Elements of Economics analysis-Quantitative and qualitative analysis-Economic Analysis process-Estimating magnitude and time of future cash inflows and out flows-Sensitivity analysis-Project trade-offs-Trade-offs rules-Limitation of quantitative analysis-Influence of qualitative factors on project success

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Harry Peck, Designing for Manufacture, Pitman Publications, 1983.
2. George E Dieter, Engineering Design,McGraw-Hill Int Editions, 2000

**REFERENCES:**

1. S.S.Iyer ,Value Engineering, New Age International, 2000
2. Charles E. Ebeling, Reliability and Maintainability Engineering, , TMH, 2000

**PD9251 MICRO ELECTRO MECHANICAL SYSTEMS L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 8**

Introduction, Materials-substrates, Additive materials. Fabrication techniques-Deposition, Lithography, etching, Surface micro machining, Thick film screen-printing and electroplating

**UNIT II MECHANICAL SENSOR PACKAGING 8**

Introduction, Standard IC packages-ceramic, plastic and metal packages. Packaging process-Electrical interconnects, Methods of die attachment, sealing techniques. MEMS mechanical sensor packaging

**UNIT III MECHANICAL TRANSDUCTION TECHNIQUES 9**

Piezo resistivity, Piezoelectricity, Capacitive Techniques, Optical techniques, Resonant techniques. Actuation techniques, Smart Sensors. MEMS Simulation and Design tools-Behavioral model ling simulation tools and Finite element simulation tools.

**UNIT IV PRESSURE SENSORS 12**

Introduction. Techniques for sensing. Physics of pressure sensing-Pressure sensor specifications. Dynamic pressure sensing. Pressure sensor types. MEMS technology pressure sensors-Micro machined silicon diaphragms,

**UNIT V FORCE, TORQUE AND INERTIAL SENSORS 8**

Introduction-Silicon based devises-Optical devises-capacitive devises-Magnetic devices-Atomic force microscope and scanning probes- micro machined accelerometer-Micro machined Gyroscope-Future inertial micro machined sensors

**TEXT BOOK**:

1. Nadim Maluf and Kirt Williams,' An introduction to Micro electro mechanical System Engineering, Artech House, Inc. Boston.2003

**REFERENCE:**

1. Stephen Beeby, Graham Ensell, Michael Kraft and Neil White,' MEMS Mechanical sensors' Artech House, Inc. Boston 2003

**PD9252 CREATIVITY IN DESIGN L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 4**

Need for design creativity – creative thinking for quality – essential theory about directed creativity –

**UNIT II MECHANISM OF THINKING AND VISUALIZATION 11**

Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmmetry.Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking

**UNIT III CREATIVITY 11**

Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management

**UNIT IV DESIGN 9**

Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective- Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management

**UNIT V INNOVATION 10**

Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator's solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton

**TOTAL : 45 PERIODS**

**REFERENCES:-**


1. Rousing Creativity: Think New NowFloyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999
2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
3. Donald A. Norman," Emotional Design", Perseus Books Group New York , 2004
4. Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2003
5. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000

**PD9253 REVERSE ENGINEERING L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 5**
Scope and tasks of RE - Domain analysis- process of duplicating

**UNIT II TOOLS FOR RE 8**
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation - software and application- prototyping - verification

**UNIT III CONCEPTS 12**
History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

**UNIT IV DATA MANAGEMENT 10**
Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics

**UNIT V INTEGRATION 10**
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association


**PD9254 ENTERPRISE RESOURCE PLANNING L T P C**
**3 0 0 3**

**UNIT I ENTERPRISE RESOURCE PLANNING 10**
Principle – ERP framework – BusinessBlue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models

**UNIT II TECHNOLOGY AND ARCHITECTURE 10**

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.

**UNIT III ERP SYSTEM PACKAGES 10**

SAP,. People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues.

**UNIT IV 7**

Overview – Architecture – AIM – applications – Oracle SCM. SAP : Overview – Architecture – applications -Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET

**UNIT V ERP PROCUREMENT ISSUES 8**

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
2. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
3. Vinod Kumar Crag and N.K.Venkitakrishnan , Enterprise Resource Planning – Concepts and Practice, Prentice Hall of India, 1998.
4. ERPWARE , ERP Implementation Framework, Garg & Venkitakrishnan, Prentice Hall, 1999.
5. Thomas E Vollmann and Bery Whybark , Manufacturing and Control Systems, Galgothia Publications, 1998.