

NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)

Erode-638 052, Tamil Nadu, India, Phone: 04294 – 225585



CURRICULUM AND SYLLABUS

FOR

M.E – ENGINEERING DESIGN (R13)

(The Curriculum and Syllabi are applicable to Students admitted from the academic year 2013-2014 onwards)

AUGUST 2013

NANDHA ENGINEERING COLLEGE, ERODE-52

REGULATION[R13] I SEMESTER CURRICULUM

M.E. (Engineering Design) – Full Time

SEMESTER I

THEORY					
Course code	Course Title	L	T	P	C
13ED101	Applied Mathematics for Engineering Design	3	1	0	4
13ED102	Concepts of Engineering Design	3	0	0	3
13ED103	Computer Applications in Design	3	0	0	3
13ED104	Finite Element Methods in Mechanical Design	3	1	0	4
E1	Elective I	3	0	0	3
E2	Elective II	3	0	0	3
PRACTICAL					
Course code	Course Title	L	T	P	C
13ED111	CAD Lab	0	0	3	2
TOTAL		18	2	3	22

SEMESTER II

THEORY					
Course code	Course Title	L	T	P	C
13ED201	Design for Manufacture, Assembly and Environments	3	0	0	3
13ED202	Mechanisms Design and Simulation	3	1	0	4
13ED203	Mechanical Behavior of Materials	3	0	0	3
13ED204	Vibration Analysis and Control	3	1	0	4
E3	Elective III	3	0	0	3
E4	Elective IV	3	0	0	3
PRACTICAL					
Course code	Course Title	L	T	P	C
13ED211	Analysis and Simulation Lab	0	0	3	2
13ED212	Industrial Visit & Technical Seminar	0	0	3	2
TOTAL		18	2	6	24

SEMESTER III

THEORY					
Course code	Course Title	L	T	P	C
E5	Elective V	3	0	0	3
E6	Elective VI	3	0	0	3
E7	Elective VII	3	0	0	3

PRACTICAL					
Course code	Course Title	L	T	P	C
13ED321	Project Work (Phase I)	0	0	12	6
TOTAL		9	0	12	15

SEMESTER IV

PRACTICAL					
Course code	Course Title	L	T	P	C
13ED421	Project Work (Phase II)	0	0	24	12
TOTAL		18	0	24	12

TOTAL CREDITS: 22+24+15+12=73

NANDHA ENGINEERING COLLEGE, ERODE-52

REGULATIONS [R 13] I SEMESTER CURRICULUM

M.E. Engineering Design - Part Time

SEMESTER I

THEORY					
Course code	Course Title	L	T	P	C
13ED101	Applied Mathematics for Engineering Design	3	1	0	4
13ED102	Concepts of Engineering Design	3	0	0	3
13ED103	Computer Applications in Design	3	0	0	3
TOTAL		9	1	0	10

SEMESTER II

THEORY					
Course code	Course Title	L	T	P	C
13ED201	Design for Manufacture, Assembly and Environments	3	0	0	3
13ED202	Mechanisms Design and Simulation	3	1	0	4
13ED203	Mechanical Behavior of Materials	3	0	0	3
TOTAL		9	1	0	10

SEMESTER III

THEORY					
Course	Course Title	L	T	P	C
13ED104	Finite Element Methods in Mechanical Design	3	1	0	4
E1	Elective I	3	0	0	3
E2	Elective II	3	0	0	3

PRACTICAL					
Course	Course Title	L	T	P	C
13ED111	CAD Lab	0	0	3	2
TOTAL		9	1	3	12

SEMESTER IV

THEORY					
Course code	Course Title	L	T	P	C
13ED204	Vibration Analysis and Control	3	1	0	4
E3	Elective III	3	0	0	3
E4	Elective IV	3	0	0	3

PRACTICAL					
Course code	Course Title	L	T	P	C
13ED211	Analysis and Simulation Lab	0	0	3	2
13ED212	Industrial Visit & Technical Seminar	0	0	3	2
TOTAL		9	1	6	14

SEMESTER V

THEORY					
Course code	Course Title	L	T	P	C
E5	Elective V	3	0	0	3
E6	Elective VI	3	0	0	3
E7	Elective VII	3	0	0	3

PRACTICAL					
Course code	Course Title	L	T	P	C
13ED321	Project Work (Phase I)	0	0	12	6
TOTAL		9	0	12	15

SEMESTER VI

PRACTICAL					
Course code	Course Title	L	T	P	C
13ED421	Project Work (Phase II)	0	0	24	12
TOTAL		18	0	24	12

LIST OF ELECTIVES

M.E ENGINEERING DESIGN (FULL TIME AND PART TIME)

ELECTIVES					
Course code	Course Title	L	T	P	C
13EDX01	Integrated Manufacturing Systems	3	0	0	3
13EDX02	Mechatronics in Manufacturing systems	3	0	0	3
13EDX03	Optimization Techniques in Design	3	0	0	3
13EDX04	Engineering Fracture Mechanics	3	0	0	3
13EDX05	Tribology in Design	3	0	0	3
13EDX06	Advanced Mechanics of Materials	3	0	0	3
13EDX07	Composite Materials and Mechanics	3	0	0	3
13EDX08	Applied Engineering Acoustics	3	0	0	3
13EDX09	Advanced Tool Design	3	0	0	3
13EDX10	Productivity Management and Re-Engineering	3	0	0	3
13EDX11	Industrial Robotics and Expert systems	3	0	0	3
13EDX12	Design of Material Handling Equipments	3	0	0	3
13EDX13	Plasticity and Metal Forming	3	0	0	3
13EDX14	Theory of Plates and Shells	3	0	0	3
13EDX15	Design of Pressure Vessel and Piping	3	0	0	3
13EDX16	Modal Analysis of Mechanical Systems	3	0	0	3
13EDX17	Design of Fluid Power systems	3	0	0	3
13EDX18	Experimental Stress Analysis	3	0	0	3
13EDX19	Maintenance Engineering	3	0	0	3
13EDX20	Bearing Design and Rotor Dynamics	3	0	0	3
13EDX21	Rapid Prototyping and Tooling	3	0	0	3
13EDX22	Design of Heat Exchangers	3	0	0	3
13EDX23	Computational Fluid Dynamics	3	0	0	3
13EDX24	Supply Chain Management	3	0	0	3
13EDX25	Design Paradigm	3	0	0	3
13EDX26	Micro Electro Mechanical Systems	3	0	0	3
13EDX27	Creativity in Design	3	0	0	3
13EDX28	Reverse Engineering	3	0	0	3
13EDX29	Enterprise Resource Planning	3	0	0	3
13EDX30	Mini Project	3	0	0	3

13ED101 APPLIED MATHEMATICS FOR ENGINEERING DESIGN

L	T	P	C
3	1	0	4

OBJECTIVE:

- To gain knowledge on applications of calculus in engineering design.
- To apply critical thinking to solve applied problems.
- To use knowledge and skills necessary for immediate employment or acceptance into a graduate program.
- To maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.

LEARNING OUTCOME:

- Apply mathematical concepts and principles to perform computations
- Apply mathematics to solve problems
- Create, use and analyze graphical representations of mathematical relationships
- Communicate mathematical knowledge and understanding
- Apply technology tools to solve problems
- Perform abstract mathematical reasoning
- Learn independently

UNIT I: 2-D RANDOM VARIABLES

(9+3)

Joint distributions – Marginal and Conditional distributions – functions of two – dimensional random variables – Regression curve - Correlation.

UNIT II: COMPUTATIONAL METHODS IN ENGINEERING

(9+3)

Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace's and Poisson equation – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank- Nicolson implicit scheme – Solution of wave equation

UNIT III: TENSOR ANALYSIS

(9+3)

Summation convention – Contravariant and covariant vectors – contraction of tensors – inner product – quotient law – metric tensor – Christoffel symbols – covariant differentiation – gradient, divergence and curl

UNIT IV: CALCULUS OF VARIATION

(9+3)

Variation and its properties – Euler's equation – functionals dependent on first and higher order derivatives – functionals dependent on functions of several independent variables – problems with moving boundaries – direct methods – Ritz and Kantorovich methods

UNIT V: FAST FOURIER TRANSFORM

(9+3)

Discrete Fourier transform – linearity and periodicity – inverse N-point DFT – DFT approximation of Fourier coefficients – sampled Fourier series – Approximation of Fourier transform by an N-point DFT – FFT – Computational efficiency of FFT

TOTAL: L: 45 + T: 15 = 60 PERIODS

REFERENCES:

1. James.G, “Advanced Modern Engineering Mathematics”, 3rd edition, Pearson Education, 2004.
2. Grewal.B.S, “Numerical methods in Engineering and Science”, 7th edition, Khanna Publishers, 2005.
3. Grewal.B.S, “Higher Engineering Mathematics”, 40th edition, Khanna Publishers, 2007.
4. Gupta.A.S, “Calculus of variations with applications”, Prentice-Hall of India, New Delhi, 1997.
5. O'Neil.P.V, “Advanced Engineering Mathematics”, Thomson Asia Pvt. Ltd., Singapore, 2003.
6. Andrews.L.C and Philips.R.L, “Mathematical Techniques for Engineers and Scientists”, Prentice Hall of India, 2006.

13ED102 CONCEPTS OF ENGINEERING DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the fundamentals of design process and products.
- To understand the selection of proper materials.
- To understand legal, ethical environmental and safety issues in design.
- To understand the environmental conscious design.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the design concepts in various industrial products based on customer requirements
- Apply statistical tools in monitoring the product performance
- Apply the design concepts to produce products with high efficiency.

UNIT I : DESIGN FUNDAMENTALS

(9)

Importance of design- The design process-Considerations of Good Design –Morphology of Design –Organization for design– Computer Aided Engineering –Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

UNIT II : CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS

(9)

Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

UNIT III : DESIGN METHODS

(9)

Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture- Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Geometric Modeling –Rapid prototyping- Finite Element Analysis– Optimization – Search Methods.

UNIT IV : MATERIAL SELECTION PROCESSING AND DESIGN

(9)

Material Selection Process – Economics – Cost vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

UNIT V : PROBABILITY CONCEPTS IN DESIGN &GREEN DESIGN PROCESS

(9)

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance-Robust Design-Failure mode Effect Analysis. GREEN DESIGN PROCESS: Material life cycle, embodied energy, 80-20 rule, carbon footprint, green design in industry, sustainability,biomimetics.

TOTAL: 45 PERIODS

REFERENCES:

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", 4th Edition, Tata McGraw Hill Education, 2013.
2. Pahl, G, and Beitz, W., "Engineering Design", 3rd Edition, Springer – Verlag, NY. 2007.
3. Ray, M.S., "Elements of Engg. Design", Prentice Hall Inc. 1985.
4. Suh, N.P., "The Principles of Design", Oxford University Press, NY.1990.
5. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development" 4th Edition, McGraw Hill, 2009

13ED103 COMPUTER APPLICATIONS IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To develop the modelling skills using computer graphic techniques for line, curves, surfaces and solids.
- To impart knowledge on CAD software"s and data exchange standards.
- To gain knowledge on visual realism and computer animation

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Create CAD models for various products which include parts, assembly etc.,
- Simulate the physical system using a CAD model.

UNIT I : INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS (9)

Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation. Representation of curves – Bezier curves - cubic spline curve - B – Spline curves - Rational curves, Open GL Data Exchange standards – IGES, STEP etc.– Communication standards

UNIT II : INTRODUCTION TO CAD SOFTWARE (9)

Writing interactive programs to solve design problems and production of drawings - using any languages like Auto LISP/C/FORTRAN etc.- creation of surfaces – solids etc. using solid modeling packages (prismatic and revolved parts).

UNIT III : SOLID MODELING (9)

Regularized Boolean set operations - primitive instancing – sweep representations - boundary representations - constructive solid Geometry comparison of representations - user interface for solid modeling. –Surface Modeling techniques - surface patch – Coons patch- bi cubic patch – Bezier and B-spline surfaces – Volume modeling.

UNIT IV : VISUAL REALISM (9)

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software"s and their principles creation of prismatic and lofted parts using these packages.

UNIT V : ASSEMBLY OF PARTS (9)

Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation.

TOTAL: 45 PERIODS

REFERENCES:

1. Donald Hearn and M. Pauline Baker "Computer Graphics", 4th Edition, Prentice Hall, Inc., 2010.
2. Ibrahim Zeid, "Mastering CAD/CAM", 2nd Edition, McGraw Hill, International Edition, 2006.
3. William M Neumann and Robert F.Sproul, "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
4. P.Radhakrishnan and C.P. Kothandaraman, "Computer Graphics and Design", Dhanpat Rai and Sons, 1999.
5. Foley, Wan Dam, Feiner and Hughes, "Computer graphics principles & practices", Pearson Education – 2003.
6. Donald Heam and M. Pauline Baker "Computer Graphics", 3rd Edition, Prentice Hall, Inc.,2003.

13ED104 FINITE ELEMENT METHODS IN MECHANICAL DESIGN

L	T	P	C
3	1	0	4

OBJECTIVE:

- To understand 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.
- To create expertise in basic elements - one and two dimensional problems - Isoperimetric elements - static & dynamic analysis in structural, heat transfer and fluid flow.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply Finite Elements Techniques in engineering problem solving for various applications.
- Write programs with a coding software to solve real time problems.

UNIT I : INTRODUCTION & ONE-DIMENSIONAL PROBLEMS

(10+3)

Relevance of finite element analysis in design - Variational principles and methods –Weighted Integral statements –Weak formulations – Ritz method – Method of weighted residuals – Applications of FEA - Finite element modeling – Coordinates and shape functions - Potential energy approach – Galerkin” s approach – One dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams.

UNIT II : TWO-DIMENSIONAL PROBLEMS

(10+3)

Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications – Conduction and convection heat transfer – Torsional cylindrical member – Transient analysis - Theory of elasticity – Plane strain – Plane stress – Axi-symmetric problems –Principle of virtual displacement.

UNIT III : ISOPARAMETRIC ELEMENTS

(8+3)

Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications.

UNIT IV : STRUCTURAL DYNAMICS APPLICATIONS

(9+3)

Dynamic equations – Mass and damping matrices – Natural frequencies and modes – Reduction of number of DOF response history – Model methods – Ritz vectors – Component mode synthesis – Harmonic response – Direct integration techniques – Explicit and implicit methods.

UNIT V : NON-LINEAR PROBLEMS & ERROR ESTIMATES

(8+3)

Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity – Geometric non-linearity – Large displacement – Error norms and convergence rates – H-refinement with adaptivity – adaptive refinement.

TOTAL: 45L+15T:60 PERIODS

REFERENCES:

1. Reddy J.N., “An Introduction to the Finite Element Method”, Third Edition, McGraw Hill, International Edition, 2005.
2. Logan D.L, “A First Course in the Finite Element Method”, 5th Edition, Thomson Learning, 2012.
3. Cook, Robert Davis et al “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley, John & Sons, 2007,
4. Segerlind L.J., “Applied Finite Element Analysis”, 2th Edition, John Wiley, 2010.
5. S.S.Rao, “Finite Element Analysis”, 2002 Edition.
6. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, 6th Edition, McGraw Hill International Edition, Physics Services, 2005.

13ED111 CAD LAB

L	T	P	C
0	0	3	2

OBJECTIVE:

- To develop the modelling skills using computer graphic techniques for line, curves, surfaces and solids.
- To impart knowledge on CAD software"s and data exchange standards.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Create CAD models for various products which include parts, assembly etc.,
- Simulate the physical system using a CAD model.

■

Study of CAD

- **Study of Sketcher**
- **Solid modeling** –Extrude, Revolve, Sweep, etc. and Variational sweep, Loft, etc.
- **Surface modeling** –Extrude, Sweep, Trim etc. and Mesh of curves, Free form etc.
- **Feature manipulation** – Copy, Edit, Pattern, Suppress, History operations etc.
- **Assembly**-Constraints, Exploded Views, Interference check
- **Drafting**-Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA / NX etc.

TOTAL: 30 PERIODS

13ED201 DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

L T P C

OBJECTIVE:

3 0 0 3

- To understand the principles of component design for easy manufacturing.
- To study the process capability and factors influencing form design.
- To know the machining and casting considerations for manufacturing oriented design.
- To expose the impact of design on environment to achieve eco-friendly component design

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Estimate tolerances for different dimension of a product based on the selected manufacturing process
- Select materials for particular product based on the functional requirement.

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, “Design for Assembly Automation and Product Design”, 2nd Edition, New York, Marcel Dekker, 2005
2. Bralla, “Design for Manufacture handbook”, 2nd Edition, McGraw hill, 2002
3. Boothroyd, G, Hartz and Nike, “Product Design for Manufacture”, 3rd Edition, 2012, CRS Press, 2012.
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.

13ED202 MECHANISMS DESIGN AND SIMULATION

L	T	P	C
3	1	0	4

OBJECTIVE:

- To understand the fundamentals of kinematics; and to find the velocity and acceleration of complex mechanisms.
- To understand the curves traced by the different mechanisms and its applications
- To know the principle motions of spatial and robotic mechanisms.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design a new mechanism based on the type of input and output motions required in particular product or machine.

UNIT I : INTRODUCTION

(7)

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, -Compliant mechanisms-Equivalent mechanisms.

UNIT II : KINEMATIC ANALYSIS

(11)

Analytical methods for velocity and acceleration Analysis– four bar linkage -jerk analysis. Plane complex mechanisms auxiliary point method. Spatial RGGR mechanism-Denavit-Hartenberg Parameters – Basic kinematic structures of serial and parallel robot manipulators Forward and inverse kinematics of robot manipulators.

UNIT III : PATH CURVATURE THEORY, COUPLER CURVE

(9)

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp-crunode-coupler driven six-bar mechanisms-straight line mechanisms.

UNIT IV : SYNTHESIS OF FOUR BAR MECHANISMS

(9)

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique-inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis.

UNIT V : SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS (9)

Cognate Linkages-parallel motion Linkages.Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms- determination of optimum size of cams.Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages.

TOTAL: 45 + 15: 60 PERIODS

REFERENCES:

1. Uicker, J.J., Pennock, G. R. and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2010.
2. Robert L.Norton., “Design of Machinery”, Tata McGraw Hill, 2011.
3. Sandor G.N., and Erdman A.G., “Advanced Mechanism Design Analysis and Synthesis”, Prentice Hall, 1984.
4. Amitabha Ghosh and Asok Kumar Mallik, “Theory of Mechanism and Machines”, 3rd Edition,EWLP, Delhi, 2009.
5. Kenneth J, Waldron, Gary L. Kinzel, “Kinematics, Dynamics and Design of Machinery”, John Wiley-sons, 2003.
6. Ramamurti, V., “Mechanics of Machines”, Narosa, 2005.

13ED203 MECHANICAL BEHAVIOR OF MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the properties and behavior of materials. study the metallic and non-metallic materials.
- To develop a fundamental understanding of the mechanical behaviour of engineering materials.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply knowledge of mathematics, physics and materials science to design engineering products.

UNIT I : BASIC CONCEPTS OF MATERIAL BEHAVIOR

(9)

Elasticity in metals and polymers– Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity –. Griffith” s theory,– Ductile, brittle transition in steel – High temperature fracture, creep –Deformation.

UNIT II : BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES

(9)

Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stress life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue –Failure analysis, sources of failure, procedure of failure analysis.

UNIT III : SELECTION OF MATERIALS

(9)

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV : MODERN METALLIC MATERIALS

(9)

Dual phase steels, micro-alloyed steel, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials, multi component nano structured coatings, nano films,CNT.

UNIT V : NON METALLIC MATERIALS

(9)

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – transparent plastic, reinforced plastic. Advanced structural ceramics, WC, TiC, TaC, Al₂O₃, SiC, Si₃N₄ CBN and diamond – properties, processing and applications, fracture of non metallic materials.

TOTAL: 45 PERIODS

REFERENCES:

1. George E.Dieter, “Mechanical Metallurgy”, McGraw Hill, 1989.
2. Thomas H. Courtney, “Mechanical Behavior of Materials”, 2nd edition, McGraw Hill, 2005
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G, “Selection and use of engineering materials”, 3rd edition, Butterworth-Heiremann, 1997.
4. Flinn, R.A., and Trojan, P.K., “Engineering Materials and their Applications”, 4th Edition, Jaico, 2005.
5. Metals Hand book, Vol.10, “Failure Analysis and Prevention”, 10th Edition, Jaico, 1999.
7. Ashby M.F, “Materials selection in Mechanical Design”, 2nd Edition, Butter worth 2010.

13ED204 VIBRATION ANALYSIS AND CONTROL

L	T	P	C
3	1	0	4

OBJECTIVE:

- To understand the Fundamentals of Vibration and its practical applications.
- To impart the knowledge on mechanical vibration of single degree of freedom and multidegree of freedom
- To understand the working principle and operations of various vibrations measuring instruments
- To understand the various Vibration control strategies

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Select particular method of vibration measurement based on the operating condition and environment.
- Control the vibrations of equipments used for various applications.

UNIT I : FUNDAMENTALS OF VIBRATION

(10+3)

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

UNIT II : TWO DEGREE FREEDOM SYSTEM

(7+3)

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+3)

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+3)

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+3)

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.

TOTAL: 45L + 15T = 60 PERIODS

REFERENCES:

1. Thomson, W.T., “Theory of Vibration with Applications”, 5th Edition, Pearson, 2008
2. Rao, S.S., “Mechanical Vibrations”, 5th Edition, Addison Wesley Longman, New York, 2010.
3. Rao, J.S. and Gupa, K., “Introductory Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., New Delhi, 1999.
4. Den Hartog, J.P. “Mechanical Vibrations”, Dover Publications, New York, 1990.

13ED211 - ANALYSIS AND SIMULATION LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVE:

- To impart hands-on training with software like ANSYS, ADAMS and MAT Lab.
- To simulate the real time problems by using these software and also to understand the application of analysis packages.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Analyse the engineering problem using a simulation model and find out the solutions.
- Apply knowledge CAD in mechanism simulations.

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

1. Machine elements under Static and Dynamic loads.
2. Thermal Analysis of mechanical systems.
3. Modal and Harmonic Analysis
4. Analysis of an Axis-symmetric.
5. Non-linear Structural Contact Analysis.
6. Fatigue Analysis of a component.
7. Modeling a component using Pro/E, Importing to ANSYS and Meshing

Use of kinematics and dynamics simulation software like ADAMS, MATLAB.

Analysis of velocity and acceleration for mechanical linkages of different mechanisms

TOTAL : 30 PERIODS

13ED212 INDUSTRIAL VISIT & TECHNICAL SEMINAR

L T P C

0 0 3 2

OBJECTIVE:

- To understand the real time problems during production process in industries
- To present their learning as seminar among the group of people

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Get exposure of industrial problems and latest technologies
- Able to improve communication skill



The student will make at least two technical presentations on current topics related to the specialization.



The same will be assessed by a committee appointed by the department.



The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits.



A quiz covering the above will be held at the end of the semester.

TOTAL : 30 PERIODS

13EDX01 INTEGRATED MANUFACTURING SYSTEMS

L T P C

OBJECTIVE:

3 0 0 3

- To understand the main elements in integrated manufacturing systems
- To understand the Planning, monitoring and controlling the manufacturing processes

LEARNING OUTCOME:

At the end of this course, the students would be able

- To apply the components of high technology manufacturing systems and integrate them in a coordinated fashion
- To simulate the physical system using a CAD model.

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 coding - 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.Yoram 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.

13EDX02 MECHATRONICS IN MANUFACTURING SYSTEMS

L T P C

3 0 0 3

OBJECTIVE:

- To create knowledge in Mechatronics systems and to impart the source of concepts and techniques which have recently been applied in practical situation.
- To give a framework of knowledge that allows engineers to develop an interdisciplinary understanding and integrated approach to engineering.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design and fabricate the Mechatronics systems with proper elements and controllers for automation process.
- Gain knowledge in industrial automation

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

REFERENCE :

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 Applications” 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.

13EDX03 OPTIMIZATION TECHNIQUES IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the formulation of a optimization problem, including defining Appropriate design variables, constraints and objective functions.
- To apply various approximation methods to construct a sequence of approximate structural design problems appropriate for static strength, natural frequencies, buckling and dynamic response.
- To apply appropriate algorithms for discrete design variables and multi objective optimization problems.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Find the optimum combination of parameters influencing the process/production Improve the
- effectiveness of process by proper input sources in the real time applications.

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 –functions, Lagrange multipliers - Geometric programming Indirect methods using penalty

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.

OBJECTIVE:

- To understand the elements of solid mechanics
- To understand the various crack formations and their growth in systems

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Control the crack formation in the mechanical system
- Avoid the failure of the system due to fracture.

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 – Dugdale model – determination of J 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 – K_{Ic} 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 K_{Ic} 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

13EDX05 TRIBOLOGY IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To create the awareness of importance of tribology in design and selection of machine elements.
- To learn about concepts of wear and surface treatment

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the various lubricating systems which will reduce the friction and wear rate.
- Gain knowledge about lubricants and their physical properties

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 Somerfield 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, “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

13EDX06 ADVANCED MECHANICS OF MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the deformation of bodies under the different loads.
- To understand dynamics of stresses in various sections

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the failure theory concepts while designing products.
- Gain knowledge about stress distribution

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 walltubes.

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 allowablespeeds. Methods of computingcontact stress- deflection of bodies in point and line contact applications.

TOTAL: 45 PERIODS

REFERENCES:

1. Arthur 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.

13EDX07 COMPOSITE MATERIALS AND MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the composite materials as alternate materials for present design and verify the performance .
- Gain knowledge about stress and strain distribution

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”, Maneeel Dekker Inc, 1993.
3. Halpin, J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co., 1984.
4. Garwal, 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, “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

13EDX08 APPLIED ENGINEERING ACOUSTICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the basic concepts of acoustics and characteristics of sound.
- To understand the assessment and measurement of sound and the basic concepts of noise control.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Measure and control the sound which is affecting the system and environment.
- Design systems with acoustics perspective

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.

13EDX09 ADVANCED TOOL DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the fundamentals of design process and products.
- To understand the selection of proper materials and design for manufacture.
- To understand various types of tools and their application.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the design concepts in various industrial tools.
- Understand the standards in tool design

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. Cyril 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

13EDX10 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To integrate the concepts of productivity models, organization transformation and Re-engineering process.
- To know the system approach to productivity measurement.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the productivity improvement concepts in industries.
- Apply the re-engineering tools and techniques for performance improvement

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.

13EDX11 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart the design concepts, parts and types of robots
- To create expertise in various drive systems of robot, sensors and their applications, programming, justification, implementation and safety of robot.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the operating and control system to the robots.
- Apply the robot for various industrial applications

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.

13EDX12 DESIGN OF MATERIAL HANDLING EQUIPMENTS

(Use of Approved Data Book is permitted)

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart basic concepts of material handling, types, selection and its application.
- To give comprehensive insight in to design of hoists, conveyers and elevators.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design the various equipments for material handing in industries
- Able to understand the requirement for material handing in industries

UNIT I : MATERIALS HANDLING EQUIPMENT

(5)

Types, selection & 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.

13EDX13 PLASTICITY AND METAL FORMING

L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about different plastics and their processing techniques.
- To know various types of mould design.

LEARNING OUTCOME:

At the end of this course, the students would be

- able to Know the theory of plasticity
- Apply the advanced metal forming process for engineering applications.

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 –Super plastic 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. 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.

13EDX14 THEORY OF PLATES AND SHELLS

L T P C
3 0 0 3

OBJECTIVE:

- To impart equations of elasticity, classical theory of plates and
- vibration To impart the basic knowledge on thin shells

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Get the capability to design and analyse the plates and shells in their normal design practice for engineering applications

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", CRC 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, New York 1990.
4. Wilhelm Flügge, "Stresses in shells", Springer – Verlag 2001

13EDX15 DESIGN OF PRESSURE VESSELS AND PIPING

L T P C
3 0 0 3

OBJECTIVE:

- To educate the means of flow distribution and stress analysis in pressure vessels.
- To understand the stress analysis of piping layout

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design the pressure vessels and piping layout for industrial applications.

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.

13EDX16 MODAL ANALYSIS OF MECHANICAL SYSTEMS

L T P C
3 0 0 3

OBJECTIVE:

- To understand the concept of modal analysis and the measurement techniques
- To understand the extraction methods and to derive the mathematical models.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the mobility measurement techniques, modal parameter extraction methods and mathematical for easy solving of engineering problems.

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 SDOF 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.

OBJECTIV

- To impart knowledge on fluid power engineering and power transmission systems
- To create expertise in applications of fluid power systems in automation of machine tools and others equipment
- To design hydraulic and electro-hydraulic systems for automation, pneumatic system circuits and to design low cost automation systems.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design, installation and maintenance of the hydraulic and pneumatic circuits for various engineering applications.

UNIT I : OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS**(9)**

Fluids – Properties - Types of Fluid power system - Hydraulic Power Generators – Selection and specification of pumps - Pump characteristics. Linear and Rotary Actuators – Selection, Specification and characteristics.

UNIT II : CONTROL AND REGULATION ELEMENTS**(6)**

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

UNIT III : HYDRAULIC CIRCUITS**(9)**

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**(12)**

Fundamentals of Pneumatic- 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**(9)**

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 Esposito, “Fluid Power with Applications”, Pearson education 2008
2. A.Dudley, Pease and J. J. Pippenger, “Basic fluid power”, Prentice Hall. 2010
3. Andrew Parr, “Hydraulic and Pneumatic”, Jaico Publishing House 2004.
4. Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1997.

13EDX18 EXPERIMENTAL STRESS ANALYSIS

L T P C
3 0 0 3

OBJECTIVE:

- To understand the measurement of vibrations, acoustics and distress
- To understand the various NDT methods

LEARNING OUTCOMES:

At the end of this course, the students would be able to

- Apply the various vibrations, acoustics and distress methods for controlling and maintenance of machineries.

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

13EDX19 MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart the contemporary maintenance management methods and techniques.
- To study about the safety and other aspects of maintenance functions

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the various maintenance methods and schedules for smooth and safe running of machineries so that to improve the life time of machineries.

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 - -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. K.Venkataraman, “Maintenance Engineering and Management”, 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.

13EDX20 BEARING DESIGN AND ROTOR DYNAMICS

L T P C
3 0 0 3

OBJECTIVE:

- To understand the various types of bearing and its applications.
- To know the steps involved in the selection of bearings

LEARNING OUTCOMES:

At the end of this course, the students would be able to

- Design and analyse the different types of bearings under different load conditions for different applications.

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- Fatigue 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 journalbearings - computation and measurements of journalbearing 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

13EDX21 RAPID PROTOTYPING AND TOOLING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the latest manufacturing techniques for rapid production
- To know the CAD model preparation

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the tools and techniques for rapid production of products with complicated shapes at low cost.

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

REFERENCES

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

13EDX22 DESIGN OF HEAT EXCHANGERS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To build the necessary background for the design of the various types of heat exchangers. To
- learn the thermal and stress analysis on various parts of the heat exchangers

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the concepts and knowledge to design and 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.

13EDX23 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

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.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Generate the governing equations for heat and fluid flow with conduction, convection and turbulence modes in engineering applications.

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 – Vorticity 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, $K - \epsilon$ 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. Ghoshdasdar, 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.

13EDX24 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the basics of logistics
- To understand the supply chain management models and supply chain activity systems To
- use of various tools and techniques for effective management of supply chain

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Define business concepts and theories underlying supply chain management
- Summarise the nature of different kinds of flows (e.g. information, money and product) within the supply chain.
- Describe how supply chains can be managed more effectively.

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 ninteens- How to become mean, lean and world class competitor", Van Nostrand Reinhold, NY, 1992.

13EDX25 - DESIGN PARADIGM

L T P C
3 0 0 3

OBJECTIVE:

- To study about the design methodologies for manufacture and assembly
- To know the Value engineering techniques and analysis of product development.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Estimate tolerances for different dimension of a product based on the selected manufacturing process
- Design the elements of products for easy manufacturing and assembling in different manufacturing processes.

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 WELDMENT

(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 form 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

13EDX26 - MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge on micro actuation techniques, scaling laws and scaling in mechanical applications.
- To know the different types of sensors.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Design the various micro electro mechanical sensors for engineering and medical applications.
- Design micro electro mechanical systems.

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-Siliconbased devices-Optical devices-capacitive devices-Magnetic devices-Atomic force microscope and scanning probes- micro machined accelerometer-Micro machined Gyroscope-Future inertial micro machined sensors.

TOTAL: 45 PERIODS

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.

13EDX27 CREATIVITY IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

To impart the knowledge on design process, and its requirements

To understand the concepts of creativity in design

LEARNING OUTCOME:

At the end of this course, the students would be able to

Understand the mechanism of thinking and visualization.

Know to achieve creativity and innovation

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 symmetry. 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 – Visceral, 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 - Commoditization and DE-commoditization – 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 Now Floyd 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

13EDX28 - REVERSE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the concepts of Reverse Engineering.
- To know the different types of Reverse Engineering tools.

LEARNING OUTCOME:

At the end of this course, the students would be able to

- Apply the Reverse Engineering tools and techniques for development of products.
- Know Data management and integration in Reverse Engineering

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

13EDX29 - ENTERPRISE RESOURCE PLANNING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To know the basics and principles of ERP
- To understand the key implementation of ERP
- To be aware of products in the area of ERP and to appreciate the current and future trends in ERP.

LEARNING OUTCOMES:

At the end of this course, the students would be able to

- Know the ERP system packages
- Handling ERP tools in various areas like production planning, material management, human resources, finance, sales etc.

UNIT I : ENTERPRISE RESOURCE PLANNING:

(10)

Principle – ERP framework – Business Blue 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 : ERP ARCHITECTURE

(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.