St.' PETER'S UNIVERSITY
St' Peter's Institute of Higher Education & Research
Avadi, Chennai – 54

M.E (Engg. Designs)

SEMESTER – I

108EDPT01 Applied Mathematics
(Mechanical)

1. CALCULUS OF VARIATION

Introduction – Euler's equation – several dependent variables Lagrange's equation of Dynamics – Integrals involving derivatives higher that the first – Problem with constrains- Direct methods and eigen value problems.

9

2. MATRIX THEORY

Eigen values using QR transformations – generalized eigenvectors – canonical forms- singular value decomposition and applications – pseudo inverse – least square approximations.

9

3. LINEAR PROGRAMMING PROBLEM

Graphical method – simplex method – Big M Technique – Integer programming.

9

4. ONE DIMENSIONAL WAVE AND HEAT EQUATION

Laplace Transform methods for one- dimensional Wave equation – Displacements in a line string – Longitudinal vibration of an elastic bar – Fourier Transform methods for one dimensional Heat conduction problems in infinite and semi infinite rods.

9

5. ELLIPTIC EQUATION

Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi- infinite strip – Solution of Poisson equation by Fourier transform method.

9

L = 45 T = 15 Total No. of Periods : 60

REFERENCES:

1. Gupta, A.S , Calculus of Variations with Applications, Prentice – Hall of India New Delhi, 1997.
2. Broson, R., Matrix operations, Schaum's outline series, McGraw Hill, New York,. 1989.
3. Taha H.A, " Operation Research-An Introduction", Prentice Hall of India, 2001.
4. Sankara Rao, K., Introduction to Partial Differential Equations, Prentice – Hall of India , New Delhi, 1995.

Mechanical

108EDPTO2 CONCEPTS OF ENGINEERING DESIGN

L	T	P	C
3	0	0	3

1. 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.

2. 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.

3. 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.

4. 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.

5. Probability concepts in Design for Reliability 9

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance-Robust Design-Failure mode Effect Analysis.

Total 45

Text Books:

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.

References:

1. Pahl, G, and Beitz, W.," Engineering Design", Springer – Verlag, NY. 1984.
2. Ray, M.S., "Elements of Engg. Design", Prentice Hall Inc. 1985.
3. Suh, N.P., "The principles of Design", Oxford University Press, NY.1990.

Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" McGraw Hill Edition 2000

108EDPT03	COMPUTER APPLICATIONS IN DESIGN	L T P C 3 0 2 4

1. Introduction to Computer Graphics Fundamentals **11**

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 –Surface Modeling techniques - surface patch – Coons patch- bi-cubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG- other modeling techniques.

2. Introduction to CAD software **8**

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).

3. Solid Modeling **8**

Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.
Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

4. 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.

5. Assembly of Parts **9**

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

Note: Lab Practice of 30 hrs. Total 45 + 30 = 75 Hours

References:

1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
3. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
4. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
5. Donald Heam and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.

108EDPT04 QUALITY CONCEPTS IN DESIGN

L T P C
3 0 0 3

AIM

To study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.

1. Design for Quality 9

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

2. Failure Mode Effect Analysis 9

Basic methods: Refining geometry and layout, general process of product embodiment- Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling-Case study- computer monitor stand for a docking station.

3. Design of Experiments 9

Design of experiments-Basic methods- Two factorial experiments-Extended method-reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing-Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method.

4. Statistical consideration and Reliability

9 Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

5. Design for SIX SIGMA 9

Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving-SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services

TOTAL 45

Reference:

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, *Pearson Education (LPE), 2001.*
2. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGRAW-HILL- 3rd Edition, 2003.
3. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub:son south-western(www.swlearning.com)
4. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.

108EDPP01 **CAD LAB**

L	T	P	C
0	0	2	1

- **CAD** Introduction.
- **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-45 hr

208EDPT01 **Finite Element Methods in Mechanical Design**

L	T	P	C
3	1	0	4

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

Unit-I: General Introduction * **10**

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

Unit-II: Generalization of Finite Element Concepts and Element Shape Functions* **7**

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

Unit-III: Applications to Field Problems * **9**

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

Unit-IV: Finite Elements in Structural Dynamics and Vibrations ** **10**

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

208 EDT 701 F.E.M.M.D

Unit-V: Non-linear Analysis *** 9

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

Note

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

References

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

208EDPT02 VIBRATION ANALYSIS AND CONTROL**

L T P C
3 0 2 4

OBJECTIVE:

(i).To understand the Fundamentals of Vibration and its practical applications.
(ii).To understand the working principle and operations of various vibrations Measuring instruments
(iii).To understand the various Vibration control strategies

1. Fundamentals of Vibration 10

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

2. Two Degree Freedom System 7

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

3. Multi-Degree Freedom System and Continuous System 9

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

4. Vibration Control 9

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

5. Experimental Methods in Vibration Analysis 10

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

45 + 15 Lab Hours **Total 60**

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

Text book:

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

References:

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

208EDPT03 MECHANISMS DESIGN AND SIMULATION**

L	T	P	C
3	0	2	4

1. **Introduction** 9

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms-Equivalent mechanisms.

2. **Kinematic Analysis** 9

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

3. **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

4. **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.

5. **Synthesis of Coupler curve based Mechanisms & Cam Mechanisms** 9

Cognate Lingages-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.
Students should design and fabricate a mechanism model as term project.

Note: Tutorial/Practice: 30 Hrs Total 45 + 30 = 75 Hrs

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

208EDPT03

References:

1. Robert L.Norton., "Design of Machinery",Tata McGraw Hill, 2005.
2. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
3. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2005.
4. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.
5. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.
6. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

208EDPT04 MECHANICAL BEHAVIOR OF MATERIALS

L	T	P	C
3	0	0	3

1. Basic concepts of Material Behavior **12**

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 – Larson Miller parameter – Deformation and fracture mechanism maps.

2. Behaviour under dynamic loads and Design approaches **10**

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 – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

3. Selection of Materials **10**

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, 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.

4. Modern Metallic Materials **8**

Dual phase steels, 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.

5. Non Metallic Materials **7**

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al_2O3, SiC, Si_3N_4 CBN and diamond – properties, processing and applications.

Total 45

References:

1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behavior of Materials, (2nd edition), McGraw Hill, 2000
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (34d edition), Butterworth-Heiremann, 1997.

208 ED PTOY

4. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 1999.
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 1999.
8. www.astm.org/labs/pages/131350.htm.

108EDPT05

108EDPE03 TRIBOLOGY IN DESIGN

L T P C
3 0 0 3

1. 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

2. 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

3. 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.

4. Theory of Hydrodynamic and Hydrostatic Lubrication 12

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

5. 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

References:

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

108EDPE02 **ENGINEERING FRACTURE MECHANICS**

L T P C
3 0 0 3

1. 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.

2. Stationary Crack under Static Loading **9**

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

3. Energy balance and crack growth **9**

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

4. Fatigue crack growth curve **9**

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

5. 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

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

108EDPE04 **ADVANCED MECHANICS OF MATERIALS**

L	T	P	C
3	0	0	3

1. 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.

2. 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.

3. 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

4. Torsion of Non-Circular Sections 7

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

5. Stresses in Rotary Sections and Contact stresses 9

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

Total 45

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.

108EDPT06

108EDPE05 COMPOSITE MATERIALS AND MECHANICS

L T P C
3 0 0 3

OBJECTIVE

i) To understand the fundamentals of composite material strength and its mechanical behavior

ii) Understanding the analysis of fiber reinforced Laminate design for different

Combinations of plies with different orientations of the fiber.

iii) Thermo-mechanical behavior and study of residual stresses in Laminates during processing.

iv) Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

1. 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.

2. 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.

3. 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

4. Analysis of Laminated Flat Plates 10

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

108EDPT06

5. 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

Text Book:

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

References:

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

108EDPE06 APPLIED ENGINEERING ACOUSTICS

L T P C
3 0 0 3

1. **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.

2. **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.

3. **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.

4. **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.

5. **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

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.

208EDPT05

~~208EDPE02~~ PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L T P C
3 0 0 3

1. 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

2. 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.

3. 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.

4. RE-ENGINEERING PROCESS IMPROVEMENT MODELS

9

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

5. 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

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.

208EDPE01 ADVANCED TOOL DESIGN

L T P C
3 0 0 3

1. 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

2. 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

3. 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.

4. 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.

5. 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

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

208EDPT06

208EDPE03 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

L T P C
3 0 0 3

1. **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.

2. **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.

3. **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.

4. **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.

5. **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

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.

208EDPE04 **DESIGN OF MATERIAL HANDLING EQUIPMENTS**
(Use of Approved Data Book Is Permitted)

L	T	P	C
3	0	0	3

1. Materials Handling Equipment **5**

Types, selection and applications

2. 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.

3. 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.

4. Conveyors **10**

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

5. 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

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.

208EDPE05 **PLASTICITY AND METAL FORMING** L T P C

308EDPE03 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

1. Oil Hydraulic Systems and Hydraulic Actuators 5

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

2. Control and Regulation Elements 2

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

3. Hydraulic Circuits 5

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

4. Pneumatic Systems and Circuits 16

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

5. Installation, Maintenance and Special circuits 7

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

Total 45

References:

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

308EDPE02 **MODAL ANALYSIS OF MECHANICAL SYSTEMS**

L T P C
3 0 0 3

1. 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.

2. Theoretical Basis 12

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

3. 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.

4. 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.

5. Derivation of Mathematical Models 6

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

Total 45

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.

308EDPE16 INTEGRATED MANUFACTURING SYSTEMS

L T P C
3 0 0 3

1. INTRODUCTION 5

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

2. GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 5

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

3. 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.

4. 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.

5. 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

Text Books:

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

References:

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

46 2.0

308EDPE16 **DESIGN OF HEAT EXCHANGERS**

L	T	P	C
3	0	0	3

1. **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.

2. **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.

3. **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.

4. **COMPACT AND PLATE HEAT EXCHANGERS** 9

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

5. **CONDENSERS & COOLING TOWERS** 9

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

Total Periods 45

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

47 3 2 2

308EDPE19 MECHATRONICS IN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE

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

1. INTRODUCTION 5

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

2. 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.

3. ACTUATORS 12

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

4. PROGRAMMABLE LOGIC CONTROLLERS 8

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

5. 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

TEXT BOOK

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

REFERENCES

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

308EDPE17 **RAPID PROTOTYPING AND TOOLING**

L	T	P	C
3	0	0	3

1. 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.

2. 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.

3. 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.

4. 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.

5. Rapid Tooling **8**

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

Total Periods: 45

Text Book:

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

Reference:

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