PMA16106 ADVANCED NUMERICAL METHODS 3 2 0 4

COURSE OBJECTIVE

- To explain the ideas of mathematical operations involved, accuracy requirements, and available computational resources.
- To Illustrate the dealing between reducing the step size and using a Runge – Kutta method of higher order
- To develop finite difference algorithm techniques for elliptic, parabolic and hyperbolic partial differential equations.
- To enhance sound knowledge in characaterizing, analyzing and solving a wide range of problems using finite different schemes.
- To discuss about the finite element methods and arrangement of collocation points at boundaries between elements and domain.

UNIT I ALGEBRAIC EQUATIONS 15

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods – Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 15

Runge - Kutta Methods for system of IVPs – Numerical stability – Adams-Bashforth multistep method – Solution of stiff ODEs – shooting method – BVP: Finite difference method, orthogonal collocationmethod, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION 15

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation – Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme-Stability of above schemes.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 15

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 15

Partial differential equations – Finite element method – orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- understand the accuracy of technical computations and describe the relevance of answers, with its appropriateness.
- acquire knowledge in solving a first order explicit initial value problem using Runge – Kutta 4th order.
- understand the application of iterative techniques, explicit and implicit techniques, ADI methods used in finite difference algorithms.
- analyze the techniques, involved in constructing approximate polynomial and determining the intermediate values.
- implement the finite element method efficiently in order to solve a particular equation.

REFERENCES

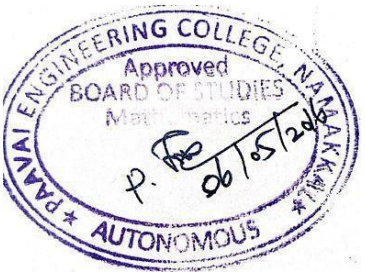
1. Saumyen Guha and Rajesh Srivastava, ―Numerical methods for Engineering and Science‖, Oxford Higher Education, New Delhi, 2010.
2. Gupta S.K., ―Numerical Methods for Engineers‖, New Age Publishers, 1995.
3. Burden, R.L., and Faires, J.D., ―Numerical Analysis – Theory and Applications‖, Cengage Learning, India Edition, New Delhi, 2009
4. Jain M. K., Iyengar S. R., Kanchi M. B., Jain , ―Computational Methods for Partial Differential Equations‖, New Age Publishers, 1993.
5. Morton K.W. and Mayers D.F., ―Numerical solution of partial differential equations‖, Cambridge University press, Cambridge, 2002.

WEB LINKS

1. https://www.youtube.com/watch?v=QTQ8bO1F-Dg
2. https://www.youtube.com/watch?v=AT7Olelic8U

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	3	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	1	3	2
CO4	3	3	2	3	-	-	-	-	-	-	-	1	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	2



PED16101 CONCEPTS OF ENGINEERING DESIGN 3 2 0 4

COURSE OBJECTIVES

- To impart the fundamentals designing cost effective, preservation and productive.
- To familiarize with the customer oriented design and societal considerations.
- To understand reinforces the knowledge being learned and shortens the overall learning of design methods.
- To know the concepts of materials for the design process.
- To acquire the knowledge in the design of reliability of failure mode effect analysis and probability concepts.

UNIT I DESIGN FUNDAMENTALS 15

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 15

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 15

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 15

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 FOR RELIABILITY 15

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

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- understand the fundamentals of design process and designing codes and standards.
- familiarize the product design specifications, ergonomics and aesthetics.
- identify the suitable design methods for problem solving.
- understand the proper material selection processing
- apply the probability concepts in design foe reliability

REFERENCES

1. Dieter, George E., ―Engineering Design - A Materials and Processing Approach‖,McGraw Hill, International Editions, Singapore, 2000.
2. Pahl, G, and Beitz, W.,‖ Engineering Design‖, Springer – Verlag, NY. 1984.
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‖McGraw Hill Edition 2000.

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CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

PED16102 COMPUTER APPLICATIONS IN DESIGN 3 2 0 4

COURSE OBJECTIVES

- To impart knowledge in computer graphics used routinely in the field of science engineering medicine etc.
- To get familiarized with the application computer graphics in designing.
- To understand the overall learning curves to solve CAE problems that arise in engineering
- To know the concepts of visuals realism to parametric and variational geometry by using software's
- To impart knowledge in the assembly of part and product data exchange.

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 17

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- bicubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG- other modeling techniques.

UNIT II INTRODUCTION TO CAD SOFTWARE 14

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 NURBS AND SOLID MODELING 14

NURBS- Basics- curves , lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing – sweeprepresentations - boundary representations - constructive solid Geometrycomparison of representations - user interface for solid modeling. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

UNIT IV VISUAL REALISM 15

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 15

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

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- familiarized with the computer graphics application in design.
- understand the reinforces to solve CAE problems using the learning curves.

- know various solid modeling Techniques and communication standards.
- apply the tolerance analysis and mass property calculations.
- analyze the optimum dimension with respect 2D and 3D

REFERENCES

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

WEB LINKS

1. www.adi.pt/docs/innoregio_cad-en.pdf
2. scholar.lib.vt.edu/ejournals/JCAEDE/v1n1/jones.html

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

PED16103 QUALITY CONCEPTS IN DESIGN 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on various concepts in engineering design and principles of implementing quality in a product or service.
- To know about the design for quality and performance metrics in design process.
- To understand the failure mode effect analysis in various mechanical aspects.
- To learn about the design of experiments in ANOVA ratio test and DOE.
- To get knowledge on design for six sigma and learn six sigma process and services.

UNIT I 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.

UNIT II 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- links fault states to systems modeling-Case study- computer monitor stand for a docking station.

UNIT III 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.

UNIT IV 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

UNIT V 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 PERIODS

COURSE OUTCOMES

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

- know the design cum quality engineer to get familiarized with various concepts in design, qualityand reliability principles in the design of an engineering product or a service.
- understand the concepts of three dimensional stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.
- get awareness on appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results.
- study the reliability and statistics in design criticality and failure effect in various charts.
- understanding of six sigma and lean manufacturing concept in industry.

REFERENCES

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVINOTTO & 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 MLindsay Pub:son south-western

WEB LINKS

1. www.swlearning.com
2. https://www.vidyarthiplus.com/.../Thread-PD-9211-—-QUALITY-CONC.
3. booksite.elsevier.com/samplechapters/.../9780750660754.PDF

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
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CO1	2	2	2	2	1	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	2	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	2

PED16104 ADVANCED MECHANICS OF MATERIALS 3 2 0 4

COURSE OBJECTIVES

- To acquire in depth knowledge in fundamental of mechanics
- To provide basic knowledge in elasticity and stress strain relations
- To familiar with stresses and deflections in beams subjected to unsymmetrical loading and buckling.
- To get knowledge in the practice of various loads like concentrated load and uniform load
- To know the principles and objectives of torsion in Non-circular section with various theories.

UNIT I ELASTICITY 15

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 AND BUCKLING 16

Location of shear center for various thin sections – shear flows. Stresses and deflections in beamssubjected to unsymmetrical loading-kern of a section. Buckling – Twist bend buckling of beams, Buckling of shafts by Torsion, Twist buckling of columns

UNIT III CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES 16

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 13

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

UNIT V STRESSES IN ROTARY SECTIONS AND CONTACT STRESSES 15

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: 75 PERIODS

COURSE OUTCOMES

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

- gain knowledge in the stresses under different loading conditions.
- know the fundamental mechanics of materials through development of basic principles in elasticity
- demonstrate the application of the knowledge in fundamental mechanics of materials to practical engineering structures
- determine the stresses resulting from bending of curved beams and flat plates.
- apply energy methods for the determination of the deflections and rotations.

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. J.P Den Hartog ―Advanced Strength of Materials‖, Courier Corporation, 1987
4. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mcmillanpub. Co., 1985.
5. Srinath. L.S., ―Advanced Mechanics of solids‖, Tata McGraw Hill, 1992.

WEB LINKS

1. http://www.me.mtu.edu
2. www.slideshare.net/.../advanced-mechanics-of-materials-by-arthur-p-bor...

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO4	3	2	3	-	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	2	3	2

PED16105 **COMPUTER AIDED DESIGN LAB** **0 0 4 2**

COURSE OBJECTIVES

- gain practical experience in handling 2D drafting and 3D modeling software systems
- gain knowledge about design and detailed drawing using software
- get practice to draw machine components like flange coupling, plummer block etc.,
- get exposure and practice to various techniques available in software for assembling machine elements

CAD INTRODUCTION

Sketcher

Solid modeling & 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 (Screw Jack, Universal Coupling, Tail stock, Flange Coupling, Plummer Block)

Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA / NX etc

COURSE OUTCOME

- develop 2D and 3D models using modeling software.
- draw part diagram using various features and options available in modeling software
- use the features of design and modeling software to assemble various componentsof machineelements like Screw Jack, Universal Joint and Safety valve etc.
- describe ability to draw and assemble any machine components using modeling sotware

TOTAL: 60 PERIODS

CO-PO Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2

SEMESTER II

PED16201 FINITE ELEMENT METHODS IN MECHANICAL DESIGN 3 2 0 4

COURSE OBJECTIVES

- To be familiar with the concepts of structures boundary conditions, co-ordinate system and various approaches to finite element criteria.
- To get in depth knowledge in the various methods of boundary value problems and elements used in different components.
- To impart knowledge about the problems involved in heat transfer, fluid mechanics and numerical examples.
- To get clear focus in degree of freedom, modal methods and analysis of response spectra.
- To learn general formulation and computational procedure for non-linear analysis.

UNIT I GENERAL INTRODUCTION 15

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 15

Boundary value problems – integral or weak statements- weighted residual methods- Gale kin method- virtual work as weak form of equations in solid and fluid mechanics- variation principles – establishment ofnatural variation principles for linear self-adjoin 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 and coordinates-order of convergence- numerical integration –example problems

UNIT III APPLICATIONS TO FIELD PROBLEMS 15

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 15

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

UNIT V NON-LINEAR ANALYSIS 15

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- modeling considerations

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- know the concepts and approaches involved in finite element analysis
- solve the problems in various finite element concepts and element shape functions.
- perform and analysis the field problems in finite element application
- evaluate the equations and concept analysis involved in FEM.
- familiar with the procedure and formulation of non-linear analysis.

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

WEB LINKS

1. https://www.osc.edu/education/si/projects/MechEng
2. www.topajka-shaw.co.nz/pdf/UFEMD1.pdf
3. https://www.osc.edu/education/si/projects/MechEng

CO-PO Mapping

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CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

PED16202 VIBRATION ANALYSIS AND CONTROL 3 0 0 3

COURSE OBJECTIVES

- To understand the Fundamentals of Vibration and its practical applications.
- To learn the working principle and operations of various vibration measuring instruments.
- To identify the various Vibration control strategies.
- To know various vibration measurement techniques.
- To analyze the various experimental methods in vibration analysis.

UNIT I FUNDAMENTALS OF VIBRATION 10

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

UNIT II TWO DEGREE FREEDOM SYSTEM 7

Introduction-Free Vibration of Undammed and Damped- Forced Vibration with Harmonic Excitation System –Coordinate Couplings and Principal Coordinates

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 9

Multi Degree Freedom System –Influence Coefficients (Stiffness and Flexibility), Generalized Co-ordinates,and Co-ordinate Coupling. Lagrangian's and Hamilton Equations – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Drunkenly, Rayleigh's, and Holzer Method - Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

UNIT IV VIBRATION CONTROL 9

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber-Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control, Basics, Piezoelectric materials, electro rheological fluids, magneto rheological fluids, shape memory alloys.

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 10

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments -FFT analyzer, vibration exciters, signal analysis. 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: 45 PERIODS

COURSE OUTCOMES

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

- understand the basics of vibration, its importance in engineering field.

- apply the working operations of various vibration measuring instruments.
- gain knowledge in the Concepts of multi-degree freedom system and continuous system .
- impart the various Vibration control and analysis techniques in the engineering field.
- demonstrate various Experimental Methods in Vibration Analysis

REFERENCES

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3. Ramamurti. V, ―Mechanical Vibration Practice with Basic Theory‖,Narosa, New Delhi, 2000
4. S. Graham Kelly & Shashidar K. Kudari, ―Mechanical Vibrations‖, Tata McGraw –Hill Publishing Com. Ltd New Delhi,2007.
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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

PED16203 MECHANISMS DESIGN AND SIMULATION 3 2 0 4

COURSE OBJECTIVES

- To understand the various mechanisms and its design.
- To learn the kinematic analysis and its applications.
- To identify mechanisms based on the strategies of motion, degrees of freedom and elements.
- To use of the simulation software in the mechanism design process.
- To apply the analysis and synthesis method to design a mechanism for a robot.

UNIT I INTRODUCTION 15

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 motionconcepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms- Equivalent mechanisms.

UNIT II KINEMATIC ANALYSIS 15

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. Graphical synthesis - Displacement – Velocity and acceleration analysis of simple mechanisms-Goodman analysis-Auxiliary point method.

UNIT III PATH CURVATURE THEORY, COUPLER CURVE 15

Fixed and moving centrodes -inflection points and inflection circle -Euler Savary equation -Bobillier's construction-Hartmann's construction–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 15

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 KINEMATICS OF ROBOT 15

Introduction -topology arrangements of robotics arms -Kinematic analysis of spatial RSSR mechanism – Denavit -Hartenberg parameters -Forward and inverse kinematics of robotic manipulators. Study and use of Mechanism using Simulation Software packages.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- familiarized with the advanced mechanism design and simulation.
- apply the kinematic analysis for different mechanism.
- gain knowledge in path curvature theory and concepts of coupler curve
- know the Synthesis of Four Bar Mechanisms, Graphical methods and Analytical methods.

- get acquaint knowledge in the Synthesis of Coupler Curve Based Mechanisms & Cam Mechanisms ideas.

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1. Robert L.Norton., ―Design of Machinery‖,Tata McGraw Hill, 2005.
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3. Uicker, J.J., Pennock, G. R. and Shigley, J.E., -Theory of Machines and Mechanisms‖, Oxford University Press, 2005.
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5. Kenneth J, Waldron, Gary L. Kinzel, -Kinematics, Dynamics and Design ofMachinery‖, John Wiley-sons, 1999.

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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Cos	**Programme Outcomes(Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

PED16204 MECHANICAL BEHAVIOR OF MATERIALS 3 0 0 3

COURSE OBJECTIVES

- To introduce the basic concepts and principles behind materials deformation, fracture, fatigue and creep.
- To learn about the mechanical behavior of structures and materials under different loading condition.
- To be focused in design and processing the materials from the atomic micro scale.
- To know the mechanical behavior metallic materials under different loading and temperature conditions.
- To provide an understanding of the mechanics and micro mechanisms of elastic and plastic deformation.

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, Hot working of metals – Larson Millerparameter – Deformation and fracture mechanism maps.

UNIT II BEHAVIOR 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, Stresslife, 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.

UNIT III SELECTION OF MATERIALS 9

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. Electrochemical Nature of Corrosion in Metals

UNIT IV MODERN METALLIC MATERIALS 9

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.

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 – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.Mechanical Behavior of Composites. **TOTAL: 45 PERIODS**

COURSE OUTCOMES

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

- familiarize the area of material behaviour under different loading and selection of materials for the design of engineering structures.
- develop the ideas of behavior under dynamic loads and design approaches.
- know selection of materials and the service requirements for various mechanical applications.
- study the Modern metallic materials, smart materials, shape memory alloys.
- understand high temperature mechanical behavior of materials.

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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 ofengineering materials, (34rd edition), Butterworth-Heiremann, 1997.
4. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications,(4th Edition) Jaico, 1999.
5. Deformation and fracture mechanics of engineering materials, 3rd Edition, R,W, Hertzbey Wiley,1989.

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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

PED16205 **ANALYSIS AND SIMULATION LAB** **0 0 4 2**

COURSE OBJECTIVES

- give exposure to software tools needed to analyze engineering problems.
- expose the students to different applications of simulation and analysis tools
- give practise to solve real time problems in air conditioning, hydraulic/pneumatic systems and cam mechanisms through simulation software C / MAT lab
- expose to stress analysis(Mechanical, thermal) and heat transfer analysis through simulation software

LIST OF EXPERIMENTS

1. Analysis of Mechanical Components – Use of FEA Packages like ANSYS/NASTRAN etc.,
2. Exercises shall include analysis of
3. Machine elements under Static loads
4. Thermal Analysis of mechanical systems
5. Modal Analysis
6. Stress Analysis of an Axis -Symmetric Component
7. Machine elements under Dynamic loads
8. Harmonic Response Analysis
9. Non-linear systems
10. Use of kinematics and dynamics simulation software like ADAMS, MATLAB. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

TOTAL: 60 PERIODS

COURSE OUTCOME

- simulate components like Air conditioning system, Hydraulic and pneumatic cylinder and camfollower mechanism.
- do simple analysis in both structural and non-structural problems.
- Solve thermal conductivity and thermal stress related problems using simulation software
- do model, analyse and simulate experiments to meet realworld system and evaluate the performance.

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
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CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2

PED16206 **DESIGN PROJECT** **0 0 2 1**

COURSE OBJECTIVES

- give an opportunity to the student to get hands on training in the fabrication ofone or more components of a complete working model, which is designed by them
- make a revision of the fundamental knowledge acquired during earlier semesters and apply to reallife problems.
- form a small team and execute a simple project in the area of design, analysis, fabrication, and thermal engineering
- identify, formulate and solve engineering problems

GUIDELINE FOR REVIEW AND EVALUATION

Each students works under a project supervisor. The product system /component(s) to be designed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the student which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- learn elements of various modeling software for modeling and analyzing real time components in a part or assembly and study their Static and dynamic characteristics
- learn the uses of design principles and develop conceptual and engineering design elementsofany components.
- fabricate any components using proper manufacturing tools.
- design a system, component, or process to meet desired needs within realisticconstraints such as economic, environmental, social, politicalsafety, manufacturability and sustainabilityaspects.

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
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CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

ELECTIVE I

PED16151 DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS 3 0 0 3

COURSE OBJECTIVES

- To know the concept of design for manufacturing, assembly and environment.
- To gain knowledge in computer application in design for manufacturing and assembly.
- To understand the selection of materials , methods, fit and tolerance concepts to design a product.
- To familiarize the basic concept of design for castings, welding, sheet metal, forging and manufacturing processes.
- To learn about the basic procedure of design for assembly and environments.

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 clamp ability - 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 energyefficiency – Design to regulations and standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- get acquainted with the design for manufacturing, assembly and environment.
- select the materials, methods, fit and tolerance to design a product.

- demonstrate the design procedure for castings, welding, forging, sheet metal and manufacturing processes.
- integrate the knowledge of compliance analysis and interference analysis for assembly.
- apply a systematic understanding of knowledge in the environmental objectives and techniques to reduce environmental impact.

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1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design.NewYork, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker,1994.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design forManufacture andStructural
5. Approach, Field Stone Publisher, USA, 1995.

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3. montalee.ie.engr.tu.ac.th/ch8english.pdf

CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

PED16152 RAPID PROTOTYPING AND TOOLING 3 0 0 3

COURSE OBJECTIVES

- To understand the rapid tooling software for rapid prototyping and rapid prototyping in manufacturing industries.
- To learn about the liquid and solid based RPT systems.
- To get knowledge of power based RPT systems.
- To understand about the techniques used in CAD modelling and reverse engineering.
- To study about the various application of rapid tooling.

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

Stereo lithography 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

COURSE OUTCOMES

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

- learn about benefits and applications of rapid prototyping and tooling.
- understand about different types of dimensional printing.
- know about various types of laser sintering methods
- get knowledge about various CAD modeling and Digitization techniques.
- get awareness about various types of tools for rapid prototyping

REFERENCES

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.
3. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

PED16153 INTEGRATED MANUFACTURING SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To know the principles of objectives of production systems and manufacturing strategies.
- To acquire in depth knowledge in the concepts of group technologies and process planning techniques.
- To be familiar with planning and control in shop floor and data collection systems.
- To get clear focus in the objectives of production monitoring, process control and inspection techniques.
- To get knowledge in the practice of various manufacturing systems, rapid prototyping and artificial intelligence through CIM.

UNIT I INTRODUCTION 5

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

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 5

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

UNIT III COMPUTER AIDED PLANNING AND CONTROL 10

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

UNIT IV COMPUTER MONITORING 10

Types of production monitoring systems-structure model of manufacturing process 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 manufacturingsystem benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- know concepts of manufacturing strategy and analysis
- study the principles of group technology and computer aided process planning.
- be familiar with production planning and cost controlling techniques.
- understand the concepts of computer controlling and monitoring systems.
- acquire knowledge in Flexible manufacturing systems

REFERENCES

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
3. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
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2. https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO1	2	-	-	-	2	-	1	2	-	-	-	1	1	1
CO2	2	-	-	-	2	-	1	2	-	-	-	1	1	1
CO3	2	-	-	-	2	-	1	2	-	-	-	1	1	1
CO4	2	-	-	-	2	-	1	2	-	-	-	1	1	1
CO5	2	-	-	-	2	-	1	2	-	-	-	1	1	1

PED16154 BEARING DESIGN AND ROTOR DYNAMICS 3 0 0 3

COURSE OBJECTIVES

- To acquire knowledge in the various types of bearings used in industries.
- To know about the basic design consideration for various bearings.
- To get clear focus in the concepts behind rolling bearings and its selections.
- To familiar with the principles of dynamics of hydrodynamic bearings.
- To know the principles of rotors under various dynamic conditions**.**

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 journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- know about the classification and selection of bearings
- design procedures in fluid film bearings.

- understand the concepts of dynamic and vibration analysis and trouble shooting techniques.
- analysis the bearings under dynamic conditions.
- familiar with concepts of rotor balancing and design configuration.

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2. Cameron, A. ―Basic Lubrication Theory‖, Ellis Herward Ltd., UK, 1981
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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

ELECTIVE II

PED16251 COMPOSITE MATERIALS AND MECHANICS 3 0 0 3

COURSE OBJECTIVES

- To study the fundamentals of composite material strength and the rule of mixtures.
- To understand the reinforced laminate for different combinations of plies with different orientations of the fiber.
- To analyze the stress, strain and failure criteria of the composite laminate.
- To know the equation of motion and analyze the bending, buckling and frequency of the composite laminate.
- To learn the thermo-mechanical behavior and isotropic and orthortropic layered structure of the laminate.

UNIT I LAMINA CONSTITUTIVE RELATIONS 12

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Agamid 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 (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina – Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Molding – Compression Molding – 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, BalancedLaminates, 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

COURSE OUTCOMES

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

- study the fundamentals and properties of composite materials and the rule of mixtures.
- understand the reinforcement of laminate for different combinations of plies and the stress-strain displacement.
- analyze the residual stress-strain and failure of the composite materials.
- study the equation of motion and analyze the laminated plate in bending and buckling.
- gain knowledge in thermo-mechanical behavior, isotropic and orthotropic structure.

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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
3. Issac M. Daniel and Ori Ishai, ―Engineering Mechanics of Composite Materials‖, Oxford University Press-2006, First Indian Edition - 2007
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5. Halpin, J.C., ―Primer on Composite Materials, Analysis‖, Technomic Publishing Co., 1984.

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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

PED16252 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts associated with the design and functioning and applications of Robots
- To study about the drives and End of tooling in Robots
- To study about the sensors used in robotics.
- To learn about analyzing robot kinematics and robot programming
- To study about the safety requirement associated with installation testing and maintenance.

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

COURSE OUTCOMES

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

- learn the fundamentals of robot working, Robot characteristics, subsystems.
- identity the drives and control systems used for different application in industrial purpose.
- find out the sensors for specific applications.

- draw the layout of robot cell at different working environment.
- explore the application of artificial intelligence techniques.

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1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, ―Robotics Control, Sensing, Vision and Intelligence‖, Mc Graw Hill, 1987.
2. Yoram Koren,‖ Robotics for Engineers' Mc Graw-Hill, 1987.
3. Kozyrey, Yu. –Industrial Robots‖, MIR Publishers Moscow, 1985.
4. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, ―Robotics Engineering – An Integrated
   Approach‖, Prentice-Hall of India Pvt. Ltd., 1984.
5. Deb, S.R.‖ Robotics Technology and Flexible Automation‖, Tata Mc Graw-Hill,1994.

WEB LINKS

1. https://www.vidyarthiplus.com/vp/Thread-ED7071-Industrial-Robotics-and-Expert-Systems-Question -Bank-VEC-Edition
2. https://books.google.co.in/books?isbn=9401167680

CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	2	-	-	-	-	-	-	2	2	2
CO5	3	-	-	-	2	-	-	-	-	-	-	2	2	2

PED16253 MECHATRONICS IN MANUFACTURING 3 0 0 3

COURSE OBJECTIVES

- To study fundamental concepts of mechatronics systems
- To acquire knowledge sensors and Transducers
- To understand the mechanisms of actuators used fundamentally in mechatronics systems
- To gain knowledge on basic concepts of programmable controllers and signal conditioning
- To impact the principles of Computer Numerical Control Systems (CNC) and microcontroller

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 – Magneto strictive - 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

COURSE OUTCOMES

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

- have a brief idea of the mechatronic systems and overview of control systems & actuators
- learn about various sensors and transducers
- understand the usage of various type actuators and their applications
- gather knowledge about various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers
- know about CNC systems structure and their application and also to know about microcontrollers

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3. Devadas Shetty and Richard A.Kolk, ―Mechatronics systems design‖, PWS Publishingcompany,2007
4. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.
5. Nitaigour Premchand Mahalik, ―Mechatronics Principles, Concepts and Applicatlions‖Tata McGraw-Hill Publishing company Limited, 2003.

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2. https://www.vidyarthiplus.com/vp/Thread-ME2401-Mechatronics-Lecture-Notes-R-M-K-Edition

CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO2	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO3	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO4	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO5	2	-	1	-	2	-	-	-	-	-	-	-	2	2

PED16254 OPTIMIZATION TECHNIQUES IN DESIGN 3 0 0 3

COURSE OBJECTIVES

- To ability to apply knowledge in optimization design techniques
- To understand basic optimization methods and its techniques.
- To familiarize about the recent trends in optimization techniques
- To study the application of static and dynamic optimization techniques
- To gain knowledge dynamic applications of various linkage mechanisms.

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES 10

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

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES 10

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

UNIT III ADVANCED OPTIMIZATION TECHNIQUES 10

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

UNIT IV STATIC APPLICATIONS 8

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

UNIT V DYNAMIC APPLICATIONS 7

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the basic principles and classification of optimization of optimization
- know the use of optimization techniques for geometric programming.
- solve the various constrained optimization problems.
- implement the static and dynamic optimization techniques.
- familiarise the optimization techniques in dynamic problems.

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
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	1	-	-	2	3	3
CO2	3	3	3	2	2	-	-	-	1	-	-	2	3	3
CO3	3	3	3	2	2	-	-	-	1	-	-	2	3	3
CO4	3	3	3	2	2	-	-	-	1	-	-	2	3	3
CO5	3	3	3	2	2	-	-	-	1	-	-	2	3	3

ELECTIVE III

PED16351 DISASTER MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

- To provide students an exposure to disasters, their significance and types.
- To understand approaches to the classifications, cause and impacts of disaster.
- To gain a basic knowledge in the approaches to Disaster Risk Reduction (DRR).
- To enhance awareness of disaster management by institutional arrangements in the county.
- To develop rudimentary ability to respond to their surroundings with potential disaster management.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –Earthquake, Landslide, Flood, Drought, Fire etc. - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, cation, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – EarlyWarning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made

disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management. **TOTAL: 45 PERIODS**

COURSE OUTCOMES

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

- differentiate the types of disasters, causes and their impact on environment and society
- assess vulnerability and various methods of risk reduction measures as well as mitigation.
- draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- identify the roles and responsibilities of community, Panchayat Raj Institutions/Urban local bodies
- analyze case studies and to devise appropriate management techniques for handling disasters in the future.

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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	3	2	2

PED16352 MANAGEMENT INFORMATION SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To provide knowledge on information systems, related issues and use of information technology.
- To make aware of global information technology and solving issues related to social challenges.
- To introduce and understand various models of e-business for application.
- To impact knowledge on consumer oriented e-commerce.
- To give input on EDI concepts and their applications in business.

UNIT I FUNDAMENTALS OF INFORMATION SYSTEMS 12

Information systems in business, fundamentals of information systems solving business problems with information systems. Business Information systems, Transaction processing systems, management information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology.

UNIT II ISSUES IN MANAGING INFORMATION TECHNOLOGY 12

Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology.

UNIT III INTRODUCTION TO E-BUSINESS 8

E-commerce frame work, Media convergence, Consumer applications, Organization applications. EBUSINESS MODEL: Architectural frame work for E-commerce, Application services and transaction Models – B2C Transactions, B2B Transactions, Intra- Organisational Transactions. WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web.

UNIT IV CONSUMER-ORIENTED E-COMMERCE 7

Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective.

UNIT V ELECTRONICS DATA INTERCHANGE (EDI) 6

EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand fundamentals of information system and its commercial applications for solving problems.
- develop an integrative knowledge of the Information Technology applied for management in organization
- gain knowledge on e-business models and web-technologies involved in organisational and commercial transactions.

- apply e-commerce models for banking, shopping, entertainment etc.
- identify components of EDI like international trade and digital signature.

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1. Sadogopan. S., -Management Information Systems" 1998Edition, PHI ISBN 81-20311809
2. Murdick. G.R., ―Information systems for modern management", 2ndEdition. PHI.
3. Jams. A O'Brien., ―Management Information systems- managing information technology in the internet worked enterprise‖ Tata McGraw Hill publishing company limited, 2002.
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2. www.nptel.ac.in/courses/122105022/

CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	3	2	2

PED16353 RELIABILITY ENGINEERING 3 0 0 3

COURSE OBJECTIVE

- To impart knowledge in reliability concepts, reliability estimation methods and reliability improvement methods
- To familiarize Data collection, distribution and plotting methods involved in reliability engineering
- To understand various reliability assessment systems
- To gain knowledge in Life testing methods involved in reliability engineering
- To understand various reliability improvement techniques

UNIT I RELIABILITY CONCEPTS 9

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of acomponent – Mortality curve – Useful life.

UNIT II LIFE DATA ANALYSIS 11

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

UNIT III RELIABILITY ASSESSMENT 10

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye's approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT IV RELIABILITY MONITORING 8

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

UNIT V RELIABILITY IMPROVEMENT 7

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the quality, reliability and other concepts of products.
- gain knowledge in data analysis through distribution methods.
- know the various systems involved in reliability assessment.
- apply reliability monitoring methods and software reliability.
- gain Knowledge on reliability improvement systems.

REFERENCES

1. Patrick D T o'connor, ―Practical Reliability Engineringt‖, John-Wiley and Sons inc, 2002.
2. David J Smith, ―Reliability, Maintainability and Risk: Practical Methods for Engineers‖, Butterworth, 2002
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4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	3	2	2

PED16354 FUNDAMENTALS OF NANOSCIENCE 3 0 0 3

COURSE OBJECTIVES

- To learn about the basis of nanomaterial science, properties and applications in different fields.
- To understand the methods of preparation of nanomaterials.
- To learn about nanoforms of carbon, nanometaloxides, their properties and applications
- To gain knowledge on characterization techniques like SEM,AFM,STM for analysis of nanomaterials
- To learn the significance and impact of nanoscience in various fields

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides- ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and

applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation

UNIT V APPLICATIONS 7

Nano InfoTech: Information storage- nano computer, molecular switch, super chip, nanocrystal, Nano bio techlogy: nano probes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- familiarize with the basics of nanomaterials science
- develop knowledge on the preparation methods of nanomaterials
- gain knowledge on the types of nanomaterials available
- acquire knowledge on various characterization techniques for analyzing nanomaterials
- know the application of nanomaterials in various fields

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2. Mark Ratner and Daniel Ratner ―Nanotechnology: A gentle introduction to the next big idea‖., Pearson Education Inc., 2003, Printice Hall/PTR, New Jersy, USA
3. John Dinardo. N, ―Nanoscale charecterisation of surfaces & Interfaces‖, 2nd edition,
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5. Timp. G, ―Nanotechnology‖, AIP press/Springer, 1999.

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CO-PO Mapping

	Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	3	2	2

PED16301 **PROJECT WORK (PHASE I)** **0 0 12 6**

COURSE OBJECTIVES

- develop ability to identify problems to solve through project works.
- get exposure to literature review related to project problem and how to find the gap.
- get exposure to required design procedure, experimental setup, analysis package to solve the identified problem.
- Prepare project reports, practice to face viva- voce examination

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

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

- identify feasible problems to solve through project works
- Collect literature through research journals and identify the gap in selected area
- Devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimisation techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project
- Prepare project report as per format and confidently face viva voce with proper PPT for presentation

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

- drive mathematical models of modal analysis for display, response, spatial and system models.

REFERENCES

1. Ewins D J, "Modal Testing: Theory and Practice ", John Wiley & Sons Inc., 1984.
2. Gaetan.Kerchen, "Modal analysis of non linear mechanical system", CISM International system,2014
3. Singiresu S.RAO, "Vibration of Continuous System",2007
4. S.K.Dwivedy, "Analysis of mechanical System", 2008
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2	2

PED16401 **PROJECT WORK (PHASE II)** **0 0 24 12**

COURSE OBJECTIVES

To enable the students to

- get trained in preparing project reports and how to face reviews and viva voce examinations.
- develop ability to identify problems to solve through project works.
- acquire knowledge on literature review related to project problem and how to find the gap.
- gain exposure to required design procedure, experimental setup, analysis package to solve theidentified problem.

COURSE OUTCOMES

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

- to take up any challenging practical problems and find solution by formulating proper methodology.
- collect literature through research journals and identify the gap in selected area
- devise the methodology to find solution through gathering complete knowledge on materials/designprocedure/analysis and optimisation techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

ELECTIVE IV

PED16451 ENGINEERING FRACTURE MECHANICS 3 0 0 3

COURSE OBJECTIVES

- To expand student‟s knowledge in the area of solid mechanics
- To impart knowledge in the area of linear-elastic fracture mechanics and the stress analysis of cracked bodies.
- To learn about energy balance and crack growth
- To understand the fatigue crack growth curve and life calculations
- To know the applications of Fracture Mechanic

UNIT I ELEMENTS OF SOLID MECHANICS 9

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

UNIT II STATIONARY CRACK UNDER STATIC LOADING 9

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin‟s approximation – plastic zone size – Dugdaale model – determination of 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 –K1c test methods - R curves - determination of collapse load.

UNIT IV FATIGUE CRACK GROWTH CURVE 9

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

UNIT V APPLICATIONS OF FRACTURE MECHANICS 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- define the basics of Solid Mechanics
- appropriately apply fracture mechanics for static loading.
- analyze crack growth mechanisms
- interpret the results of fracture mechanics analysis
- identify the cause of failures of a material based on fracture surface observations.

REFERENCES

1. David Broek, ”Elementary Engineering Fracture Mechanics “, Fifthoff and Noerdhoff International, Publisher, 1982.
2. Kare Hellan, “Introduction of Fracture Mechanics”, McGraw-Hill Book Company, 1989.
3. Preshant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 2009.

4. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1987.
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3. nptel.ac.in/courses/112106065/

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	3	1	-	-	-	-	-	2	1	2
CO2	2	2	2	2	3	1	-	-	-	-	-	2	1	2
CO3	2	2	2	2	3	1	-	-	-	-	-	2	2	2
CO4	2	2	2	2	3	1	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	1	-	-	-	-	-	2	2	2

PED16452 TRIBOLOGY IN DESIGN 3 0 0 3

COURSE OBJECTIVES

- To understand the nature of engineering surfaces, their topography and surface characterization techniques.
- To study the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- To know the properties of lubricants and lubrication regimes.
- To gain knowledge on Theory of Hydrodynamic and Hydrostatic Lubrication
- To learn the concept and application of Reynolds Equation

UNIT I SURFACE INTERACTION AND FRICTION 7

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

UNIT II WEAR AND SURFACE TREATMENT 8

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

UNIT III LUBRICANTS AND LUBRICATION REGIMES 8

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

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION 12

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

UNIT -V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION 10

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- illustrate knowledge on surface characterization techniques
- use the techniques of Surface Treatment

- apply the principles of lubrication and lubrication regimes.
- practice applications of principles and theories of hydrodynamic, elasto hydrodynamic and mixed / boundary lubrication.
- Solve numerical problems on film thickness with friction.

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 ,2014.
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

PED16453 **DESIGN OF HEAT EXCHANGER** **3 0 0 3**

COURSE OBJECTIVES

- To learn thermal analysis of various parts of the heat exchagers
- To synthesis stress analysis in the flow parameters of Heat Exchangers
- To analyse the design aspect of double pipe, finned tube, shell and tube heat exchangers
- To familirise the sizing and rating of the heat exchangers
- To acquire design knowledge on surface and evaporative condensers

UNIT I FUNDAMENTALS OF HEAT EXCHANGER **9**

Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperates – 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 PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to:

- carry out thermal analysis of heat exchanger parts
- do stress analysis in the flow parameters of heat exchangers
- analyse the design aspects of heat exchangers
- describe sizing and rating of heat exchangers
- design condensers and cooling towers of heat exchangers

REFERENCES

1. Sadik Kakac, Hongtan Liu,Heat Exchangers Selection, Rating and Thermal Design,CRC Press,2012.
2. P Arthur. Frass, Heat Exchanger Design, John Wiley & Sons, 2011.
3. Taborek.T,Hewitt.G.F and Afgan.N, Heat Exchangers,Theory and Practice,McGraw-Hill Book Co. 1983.
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2. nptel.ac.in/courses/103103027/pdf/mod1.pdf
3. www.hrs-heatexchangers.com › Home › Resources

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	2

PED16454 APPLIED ENGINEERING ACOUSTICS 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the fundamentals of acoustics and its characteristics
- To understand different ways of acuustic control in the Engineering field
- To gain basic knowledge in the trnamission of acoustics in different media
- To learn usage of sound measuring instruments along with their applications
- To familirise students with basic concepts of acoustics like sound intensity, wave equation, transmission phenonmena, measurement of sound and noise control

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 dimensions.

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, and 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 PERIODS 45

COURSE OUTCOMES

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

- show good knowledge of acoustics and noise control to design robust systems.
- become strong in the basics of acoustics, medium of sound, wave equations involved to solve problems in this area.
- comprehend the transmission of sound through different media.
- use decibal scale for measurement of sound.
- demonstrate noise control by acoustical treatment and show good grounding in acoustics.

REFERENCES

1. Lawrence E. Kinsler, Austin R. Frey, "Fundamentals of Acoustics "– John Wiley and Sons Inc., 2009.
2. Bies, David, A. and Hansen, Colin H., "Engineering Noise Control – Theory and Practice", E and FN Spon, Chapman-Hall, Second Edition, 2009.
3. Hansen C.H. and Snyder, S.D., "Active Control of Sound and Vibration", E and FN Spon, London 1997.
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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	2

ELECTIVE V

PED16551 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To understand the concepts of productivity and analyze its factors and models.
- To learn the concepts of management by objectives (MBO) and performance objective Productivity (POP).
- To study the elements of organizational transformation, reengineering principles and models.
- To familiarize the reengineering process improvement and its models like LMICIP and NPRDC
- To gain knowledge on reengineering tools, techniques and its implementation.

UNIT I PRODUCTIVITY 9

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

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 9

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

UNIT III ORGANIZATIONAL TRANSFORMATION 9

Elements of Organizational Transformation and Reengineering-Principles of organizational transformation andre-engineering, fundamentals of process reengineering, 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 PERIODS 45

COURSE OUTCOMES

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

- distinguish between macro and micro factors of productivity and describe measurement models.
- comprehend the system approach to productivity measurement.
- analyse the process of organizational transformations .
- express in-depth knowledge on re-engineering process improvement models.
- use re-engineering tools ,implementation techniques and analyze the problems involved.

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.
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5. Giles Johnston, "Business process Reengineering" 2017.

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CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	3	1	-	-	-	-	-	2	1	2
CO2	2	2	2	2	3	1	-	-	-	-	-	2	1	2
CO3	2	2	2	2	3	1	-	-	-	-	-	2	2	2
CO4	2	2	2	2	3	1	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	1	-	-	-	-	-	2	2	2

PED16552 PLASTICITY AND METAL FORMING 3 0 0 3

COURSE OBJECTIVES

- To study the theory of plasticity and its behavior.
- To familiarize the concepts of constitutive relationships and plastic instability.
- To learn to analyse problems of metal forming.
- To know thoroughly about sheet metal forming process and the theories involved.
- To acquire knowledge of various advancements in metal forming processes

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 PERIODS 45

COURSE OUTCOMES

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

- explain the concepts of plasticity and its behavior.
- analyse the mechanical properties of plastics and their instability.
- solve the metal forming problems for different shapes using different methods.
- demonstrate knowledge of sheet metal forming and various theories associated with it.
- update with various advancements in metal forming processes and their techniques.

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1. Wagoner. R H., and Chenot. J.J., Metal Forming analysis,Cambridge University Press, 2005.
2. Slater. R A. C., Engineering Plasticity - Theory & Applications to Metal Forming,John Wiely and Sons, 2001.
3. Shiro Kobayashi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Narayanaswamy. R, Theory of Metal Forming Plasticity, Narosa Publishers, 1999.
5. Surender Kumar, "Technology of Metal Forming Processes", Prentice Hall of India, New Delhi, 2008.

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2. web.itu.edu.tr/~livatyali/dersler/mak645e/ICTP08_history.pdf
3. www.ntnu.edu/studies/courses/TMT4266

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO4	3	2	3	-	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	2	3	2

PED16553 **REVERSE ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

- To introduce the basic concepts, tools, data management and integration process of re-engineering
- To know different types of Reverse Engineering tools.
- To study the reverse engineering concepts and their implementations.
- To understand the strategies, software components and evaluation models of data management.
- To learn about the reuse tools, coordinate measurement and feature capturing for integration of 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 PERIODS 45

COURSE OUTCOMES

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

- explain the scope and tasks of re-engineering
- employ Re-digitisation tools and software for analysis
- evaluate the process of RE, data generation ,verification and project implementation.
- find suitable reusable software components.
- recognize different integrating methods of RE.

REFERENCES

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corp. July1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology,1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996

5.Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 2013.

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1. people.auc.ca/xu/present/reverse.ppt
2. https://www.classle.net/#!/classle/videolink/lec-52-reverse-engineering/
3. https://en.wikipedia.org/wiki/Reverse_engineering

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	2	-	1	-	-	-	-	2	2	2
CO2	3	-	2	-	2	-	1	-	-	-	-	2	2	2
CO3	3	-	2	-	2	-	1	-	-	-	-	2	2	2
CO4	3	-	2	-	2	-	1	-	-	-	-	2	2	2
CO5	3	-	2	-	2	-	1	-	-	-	-	2	2	2

PED16554 DESIGN OF MATERIAL HANDLING EQUIPMENTS 3 0 0 3

COURSE OBJECTIVES

- To learn the types, selection and applications of materials handling equipment.
- To familiarize the applications of the chain drives, ropes and pulleys.
- To identify the handling mechanisms which are appropriate to different types of material handling.
- To acquire knowledge about various types of conveyors and its application based on the purpose.
- To know the design details of elevators and safety while handling various types of materials.

UNIT I MATERIALS HANDLING EQUIPMENT 5

Types, selection and applications

UNIT II DESIGN OF HOISTS 10

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

UNIT III DRIVES OF HOISTING GEAR 10

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

UNIT IV CONVEYORS 10

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

UNIT V ELEVATORS 10

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- select appropriate types of materials handling equipment for different.
- design various hoisting elements like chain drive, ropes and pulley.
- review hand and power drives of hoisting gear and their mechanisms for appropriate use.
- demonstrate knowledge on different types of conveyors and their applications.
- identify different types of elevators for suitable application and design fork lift trucks.

REFERENCES

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.
3. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
4. Boltzharol, A., Materials Handling Handbook, the Ronald Press Company, 1958.
5. P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.

WEB LINKS

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- www.managementstudyguide.com/material-handling.htm
- www.ehow.com › Business

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2	2

ELECTIVE VI

PED16651 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To familiarize the students with various hydraulic systems and hydraulic actuators.
- To understand the control elements and actuation systems.
- To learn to design Hydraulic circuits effectively.
- To acquire knowledge to design the pneumatic systems and circuits.
- To know about pneumatic equipments, design calculation and use of microprocessors.

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 5

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

UNIT II CONTROL AND REGULATION ELEMENTS 12

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

UNIT III HYDRAULIC CIRCUITS 5

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

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 16

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

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate knowledge on hydraulic power generator, pumps and various actuators.
- identify proper control and regulation elements.
- design appropriate hydraulic circuits for various Engineering applications.
- describe design procedure for pneumatic circuits.
- select suitable components for designing hydro pneumatic circuits.

REFERENCES

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 2013.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall,1987.
3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 2011.
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).

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2. www.nitc.ac.in/.../Chapter2_Hydraulics_control_in_machine_tools.pdf
3. newengineeringpractice.blogspot.com/.../pneumatic-complete-lecture

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO3	3	-	2	-	-	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO5	3	-	2	-	-	-	1	-	-	-	-	2	3	2

PED16652 THEORY OF PLATES AND SHELLS 3 0 0 3

COURSE OBJECTIVES

- To acquire thorough knowledge in structural mechanics, approximations of membranes, plates and shells and principles of elasticity.
- To become familiar with the concepts of classical theories, equilibrium in different coordinates, bending of plates.
- To focus on buckling analysis of plates under different compressive and boundary conditions.
- To know about the various vibrating conditions of plates under different loads conditions.
- To analyse the shells of revolution and various aspects of cylindrical and spherical shells.

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 variation methods in elasticity- virtual work-external and internal virtual work- variation operator- functional- 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 ax symmetric 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 PERIODS: 45

COURSE OUTCOMES

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

- compute structural mechanic approximations of membrane, plates and shells.
- derive equations of membrane plate and shell for analysis.
- demonstrate knowledge on the consistent derivation of approximate boundary conditions and edge effects.
- analyse and determine the static, dynamic, non-linear motion of membrane, plate and shell structures.
- perform numerical approximations of all types of shells.

REFERENCES

1. Reddy,J.N., "Theory and Analysis of Elastic Plates & Shells",C.R.C.Press,NY,USA, 2nd Edition 2006
2. Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc., 2004
3. S.Timoshenko.,"Theory of plates and shells" McGraw Hill company
4. Eduard Ventsel Theodor Krauthammer.," Thin Plates and Shells Theory, Analysis, and Applications". Marcel Dekker, 2001.
5. S.S.Bhavikatti.,"Structural analysis" Vikas publication.2011.

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2. www.math.uci.edu/~fwan/pdf/65_theoryofthinelasticshellsnotes.pdf
3. ocw.mit.edu/courses/mechanical.../2...plates-and-shells.../lecturenote.pdf

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO1	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO3	3	-	2	-	-	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO5	3	-	2	-	-	-	1	-	-	-	-	2	3	2

PED16653 DESIGN OF PRESSURE VESSELS AND PIPING 3 0 0 3

COURSE OBJECTIVES

- To give exposure to engineering problems involved in the design of pressure vessel.
- To learn about the tests and analysis for various components of pressure vessels.
- To know the procedure to design pressure vessels.
- To familiarize the buckling and fracture analysis of pressure vessels under various load conditions.
- To acquire knowledge of piping, piping layout and designing of pipes

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 PERIODS 45

COURSE OUTCOMES

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

- explain the concepts of various types of pressure vessels and their applications
- identify various stresses in different components of pressure vessels.
- design different types of pressure vessels.
- carry out fracture analysis of pressure vessels and their components
- perform stress analysis of piping.

REFERENCES

1. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 2001.
2. Henry H. Bedner, “Pressure Vessels, Design Hand Book, CBS publishers and Distributors, 1986.
3. Stanley, M. Wales, “Chemical process equipment, selection and Design.Buterworths series in Chemical Engineering, 1988.
4. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, e ASME Pressure Vessels and Piping Conference, 1997

5. https://www.mersen.com/uploads/tx_mersen/brochure-pressure-vessels_1_.pdf

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2. http://strathprints.strath.ac.uk/7495/
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CO-PO Mapping

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CO2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2	2

PED16654 MODAL ANALYSIS OF MECHANICAL SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on modal testing to perform model analysis and their applications.
- To apply the DOF in single and Multi systems and to study various dampings, vibrations for analysis.
- To understand the concepts behind the mobility measurement techniques, selection and mounting of transducers, amplifiers.
- To know the concept of peak amplitude details and get an idea to draw the time domain curve.
- To gain the analytical knowledge of different modal models for display, response, spatial and system.

UNIT I OVERVIEW 3

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 15

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

UNIT III MOBILITY MEASUREMENT TECHNIQUES 15

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 8

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 4

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- perform modal analysis and apply for dynamic structures.
- consider DOF in single and multi systems and to analyse various dampings, vibrations for different models.
- apply the concepts of mobility measurement techniques in modal tests
- utilize modal parameter extraction methods for modal analysis.