

COURSE OBJECTIVES

To enable the students to

- gain knowledge in stress, strain and elasticity deformation in 2d and 3d
- understand the concepts of energy methods for analysis of stress, strain and deflection
- learn the theory of torsion of solid section and thin walled section
- understand the shear center in symmetrical and unsymmetrical bending in beams
- acquire the knowledge of stress in thick walled cylinder under various pressures

UNIT I THEORY OF ELASTICITY**9**

Analysis of stress - Analysis of strain - Elasticity problems in two dimension and three dimensions - Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates.

UNIT II ENERGY METHODS**9**

Energy method for analysis of stress, strain and deflection The three theorem's -theorem of virtual Work - theorem of least work - Castiglione's theorem - Rayleigh Ritz method - Galion's method, Elastic behavior of anisotropic materials like fiber reinforced composites.

UNIT III THEORY OF TORSION**9**

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft.

UNIT IV UNSYMMETRICAL BENDING AND SHEAR CENTRE**9**

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section

UNIT V PRESSURIZED CYLINDERS AND ROTATING DISKS**9**

Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc. Introduction to the contact stresses.

TOTAL PERIODS 45**COURSE OUTCOMES**

Upon the completion of the course, the students will be able to

- apply the knowledge and solve elasticity problems
- analysis stress, strain and deflection using various energy methods
- demonstrate the knowledge by analyzing torsion in prismatic bars

- solve problems in unsymmetrical bending and shear center
- apply basics concepts and analysis stresses in pressurized cylinders and rotating discs.

REFERENCES

- Sadd, Martin H., Elasticity: Theory, applications and Numeric, Third edition, Amsterdam Academic Press, 2014.
- Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/McGraw Hill, 2011
- Theory of Elasticity – Timoshenko and Goodier, McGraw Hill Education (India) Private Limited, Third edition, 2010
- Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Fourth Edition, 2005
- Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 2000

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



COURSE OBJECTIVES

To enable the students to

- become familiar with transient vibrations, response of dof systems and impulse response function.
- understand multi degree of freedom systems, damped and forced vibrations and the derivation for equations of motion.
- develop knowledge on continuous systems, natural vibrations of beams, solutions by different methods, forced vibrations of simply supported beam, mode summation method and solutions by rayleigh-ritz method.
- require knowledge on different methods of vibration control, numerical and computer methods in vibration, dunkerley's method, eigen value calculations and holzers's method.
- know about basics of acoustics like plane waves, sound speed, db scale, various transmission phenomena, sound power models and its determination along with basics of psychoacoustics.

UNIT I SINGLE DEGREE FREEDOM SYSTEM 12

Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function

UNIT II MULTI DEGREE FREEDOM SYSTEM 12

Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion.

UNIT III CONTINUOUS SYSTEMS 12

Continuous Systems, Natural Vibrations of beams – Differential equation of motion, solution by the method of separation of variables, frequency parameter, natural frequencies and mode shapes, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method, discretized models of continuous systems and their solutions using Rayleigh – Ritz method

UNIT IV VIBRATION CONTROL 12

Vibration Control, Methods of vibration control, principle of superposition, Numerical and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's methods, matrix iteration method for Eigen-value calculations, Holzer's method.

UNIT V ACOUSTICS 12

Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source. Basics of psychoacoustics.

COURSE OUTCOMES

Upon the completion of the course, the students will be able to:

- predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations. They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
- write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the Eigen-values and mode shapes of natural vibrations and response to harmonic and arbitrary excitations.
- obtain the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes.
- obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunkerley's method, and Stodola's method.
- know various terminologies used in acoustics and acoustic wave transmission, derive plane and spherical wave equations, and obtain sound pressure level at a given distance from a simple sound source of known strength.

REFERENCES

1. Thomson W.T., "Theory of Vibrations with applications", Pearson E
2. R.S.Khurmi, J.K.Gupta, "Theory of Machines", S.Chand and Co, Ne
3. S.S. Rao, "Mechanical Vibrations", Pearson Education 5th edition., :
4. Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill Ir
5. Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics



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CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

COURSE OBJECTIVES

To enable the students to

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

UNIT I DESIGN FUNDAMENTALS 9

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

UNIT II CUSTOMER ORIENTED DESIGN AND SOCIETAL CONSIDERATIONS 9

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

UNIT III DESIGN METHODS 9

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

UNIT IV MATERIAL SELECTION PROCESSING AND DESIGN 9

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

UNIT V PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY 9

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

COURSE OUTCOMES

Upon the completion of the 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 for reliability

REFERENCES

1. George E.Dieter and Linda C.Schmidt, Engineering Design,McGraw Hill, 5thInternational Editions, 2012.
2. Pahl, G, and Beitz. W, Engineering Design, Springer – Verlag, London, 2007.
3. Ray, M.S., —Elements of Engg. Design, Prentice Hall Inc. 1985.
4. Suh, N.P., —The principles of Design, Oxford University Press, NY.1990.
5. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development,McGraw Hill, 5thEdition 2011.

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CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

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COURSE OBJECTIVES

To enable the students to

- acquire knowledge in cad software and hardware
- build an understanding of the fundamental concepts of computer networks
- focuses on the integration of CAD tools and role of the geometric model
- learn various geometric and orthographic curves and its surfaces
- introduce geometric modelling techniques, data structure design and algorithms for solid modelling

UNIT I INTRODUCTION TO CAD**7**

CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules

UNIT II COMMUNICATION AND NETWORK CONCEPTS**9**

Computer Communications, Principle of networking, classification networks, network wiring, methods, transmission media and interfaces, network operating systems

UNIT III GEOMETRIC TRANSFORMATIONS**10**

Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping.

UNIT IV CURVES AND SURFACES**10**

Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation

UNIT V MATHEMATICAL REPRESENTATION OF SOLIDS**9**

Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSG), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc., GD & T - types of models, types of simulation approaches.

TOTAL PERIODS 45**COURSE OUTCOMES**

Upon the completion of the course, the students will be able to

- have a conceptual understanding of the principles of cad systems, the implementation of these principles, and its connections to cam and cae systems.
- understand 2d, 3d transformations and projection transformations

SEMESTER II

PED19201

FINITE ELEMENT METHOD

3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart basic knowledge in Finite element method
- provide knowledge about shape functions and degrees of freedom
- give wide knowledge in 2D scalar variable problems
- understand the concepts of plane stress and plane strain
- analyze the natural vibration of bars and beams

UNIT I INTRODUCTION

9

Classification of problems – Dimensionality, Time dependence, Boundary Value problems, Initial value problems, Linear/Non-linear, etc.

UNIT II FINITE ELEMENT METHOD-BASIC PRINCIPLES

10

Differential equation as the starting point for FEM, steps in finite element method, discretization, types of elements used, Shape functions, Linear Elements, Local and Global coordinates, Coordinate transformation and Gauss-Legendre scheme of numerical integration, Nodal degrees of freedom

UNIT III 2D SCALAR VARIABLE PROBLEMS

9

Finite element formulation, variational, weighted residual and virtual work methods

UNIT IV 2D VECTOR VARIABLE AND AXISYMMETRIC PROBLEMS

10

1-D and 2-D problems from Structural Mechanics – Bar, Beam, Plane stress and plane strain problems, Axisymmetric problems – Axisymmetric forces and geometry

UNIT V ANALYSIS OF BEAMS

7

Eigen-value problems, Natural vibration of bars and beams, Methods to find eigen-values and eigen-vectors.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- classify the given problem on the basis of its dimensionality, time-dependence as Static or Dynamic, Linear or Non-linear.
- develop system level matrix equations, and to know the types of elements used, Gauss-Legendre scheme of numerical integration and degrees of freedom.
- understand the variational and weighted residual work methods
- know about the 1D and 2D problems from structural mechanics and plane stress, plane strain problems.
- identify the methods to find eigen-values and eigen-vectors problems

REFERENCES

1. R.Chandrupatla and Ashok.D.Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, Ed.4, 2012
2. S.S.Bhavikati, “Finite Element Analysis” New Age International Publishers.2015
3. Rao.S.S, “The Finite Element method in Engineering” 3rd Edition, Butterworth Heinemann,2012
4. Reddy J N, “An Introduction to Finite element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rd Ed., 2011
5. Bhatti Asghar.M, “Fundamentals Finite Element Analysis and Applications” John Wiley & Sons,2013

CO-PO Mapping

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CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3



COURSE OBJECTIVES

To enable the students to

- understand the formulation of Research problem
- learn about data collection and preparation process
- learn the procedure for literature survey
- learn the concept of Research proposals and Research report writing
- understand about patent rights and its importance

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research, Objectives of Research, Types of research, Significance of Research, Research process, Selecting the problem, Necessity of defining the problem, Meaning of Research design, Need for research design, features of a good design, Different research designs.

UNIT II SCALING AND DATA COLLECTION 6

Quantitative and Qualitative data, Scaling, Scaling Techniques, Experiments and Surveys, Collection of primary and secondary data, Data preparation process.

UNIT III LITERATURE SURVEY 6

Bring clarity and focus to your research problems, Improve your methodology, Procedure for reviewing the literature, search for existing literature, Develop a theoretical and conceptual framework, Writing up the literature reviewed.

UNIT IV RESEARCH PROPOSAL AND RESEARCH REPORT 6

Contents of a research proposal, Writing a research report- Research writing in general, Referencing, Writing a bibliography, Developing an outline, Plagiarism, Research ethics.

UNIT V INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property- Definition, WTO, Fundamentals of Patent, Copyright- The rights of the owner, Term of copyright, Register of Trademark, Procedure for trade mark, Term of trademark.

TOTAL PERIODS 30

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- identify research problems
- collect and prepare suitable data for research
- do literature survey in their area of research
- write research proposals and Reports
- apply their research work for patent through IPR

REFERENCES

1. C.R Kothari and Gaurav Garg, "Research Methodology Methods and Techniques", 4th Edition, New Age International Publishers.
2. Ranjit Kumar, " Research Methodology", 2nd Edition, Pearson Education, Australia.
3. M.N. Borse, " Hand Book of Research Methodology, Modern, Methods and New Techniques", Shree Niwas Publications, Jaipur.
4. Neeraj Pandey and Khushdeep Dharni, " Intellectual Property rights", PHI Learning, 2014.
5. Dr.R.Radhakrishnan and Dr.S.Balasubramanian, " Intellectual Property Rights, text and cases", Excel Books, New Delhi.

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CO3	-	-	-	3	-	2	-	2	2	2	2	2	2	2
CO4	-	-	-	-	-	2	2	2	1	3	1	1	3	1
CO5	-	-	-	2	-	-	-	3	3	-	3	1	3	2



COURSE OBJECTIVES

To enable the students to gain practical knowledge and to get hands on experience in various analysis and simulation techniques by using mechanical software tools.

LIST OF EXPERIMENTS

Analysis of Mechanical Components – Use of FEA Packages like ANSYS/NASTRAN etc.,

Exercises shall include analysis of

1. Machine elements under Static loads
 2. Thermal Analysis of mechanical systems
 3. Modal Analysis
 4. Stress Analysis of an Axis -Symmetric Component
 5. Machine elements under Dynamic loads
 6. Harmonic Response Analysis
 7. Non-linear systems
 8. Use of kinematics and dynamics simulation software like ADAMS, MATLAB.
- Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course, the students will be able to gain basis knowledge of analysis and simulation tools, and understand thermal analysis of various mechanical systems

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



COURSE OBJECTIVES

To enable the students to

- give an opportunity to the student to achieve integrated mechanical design of a product through part design assembly preparation of manufacturing drawings.
- get real time exposure to design problems to solve them using design principles.
- understand properties of different materials and apply them according to functional and structural requirements.
- get hands-on training in fabrication method, modelling techniques and product architecture.
- work as a team to develop team spirit and communication, exchange creative ideas, improve self-learning and planning skills.

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 PERIODS 60

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- use of design principles and develop conceptual and engineering design of any components
- ability to integrate the parts design with assembly and ability to prepare drawings
- select appropriate material to suit the functional requirement of the component.
- use modelling and analysis software effectively to design components and assen
- design a system with a view to fulfill social, economic , environmental, legal an in the course of development of the product.

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CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

AUDIT COURSE II

PEN19271

PEDAGOGY STUDIES

2 0 0 0

COURSE OBJECTIVES

To enable the students to

- understand the aims, objectives and educational philosophies of Education
- acquire the knowledge of Instructional objectives of teaching and teaching skills
- apply the knowledge of methods and strategies of teaching in real classroom situation
- utilize the instructional aids and tools for effective classroom teaching
- acquaint with the knowledge of professional development of teachers

UNIT I EDUCATION AND ITS PHILOSOPHY

6

Education- Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori, Jean-Jacques Rousseau, Friedrich Froebel and John Dewey.

Current trends and issues in Education-Educational reforms and National policy on Education-1968 and 1986-its objectives and features..

UNIT II INSTRUCTIONAL OBJECTIVES AND DESIGN

8

Instructional Objectives: Taxonomy of Educational objectives- Writing of general and specific objectives. Instructional design: Planning and designing the lesson.

Writing of lesson plan : meaning, its need and importance, format of lesson plan. Types of lesson plan Skills of teaching : various ways of introducing lessons, explaining skills, problem solving skills, illustrative skills, scaffolding skills, integrating ICT skills, questioning skills, Reinforcement skills, skill of probing questions, skill of stimulus variation and computation skills.

UNIT III INSTRUCTIONAL METHODS AND STRATEGIES

6

Instruction strategies – Lecture, demonstration, laboratory, Inductive method, Deductive method, Inquiry method, seminar, panel discussion, symposium, problem solving, project based learning (PBL), Learning by doing, workshop, role-play(socio-drama), Recent trends: Constructivist learning - Problem-based learning - Brain-based learning – Collaborative learning - Flipped learning - Blended learning - e-Learning trends - Video conferencing.

UNIT IV INSTRUCTIONAL MEDIA

6

Key concepts in the selection and use of media in education, Developing learning resource material using different media, Instructional aids – types, uses, selection, preparation, utilization. Dale cone of Experience, Teacher's role in procuring and managing instructional Aids – Projected and non-projected aids, multimedia, video-teleconferencing etc.,

PROGRAMME ELECTIVE II

PED19251

ADVANCED ENGINEERING MATERIALS

3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the structure of various materials and its behaviors in the engineering field.
- learn imperfection, deformation, diffusion, dislocation and strengthening mechanisms.
- create phase diagram in iron carbon system to improve and enhance their research activities.
- acquire the knowledge of various failures of metals.
- familiarize the processing of metals like ceramics, polymers and composites.

UNIT I STRUCTURE OF MATERIALS

9

Historical perspective of Materials Science - Properties of materials - Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and non-crystalline materials. Miller indices. Anisotropic elasticity. Elastic behavior of composites. Structure and properties of polymers. Structure and properties of ceramics.

UNIT II IMPERFECTIONS IN SOLIDS, DIFFUSION, DISLOCATIONS AND STRENGTHENING MECHANISMS

9

Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. Mechanisms of strengthening in metals. Recovery, recrystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles. Lattice resistance to dislocation motion.

UNIT III PHASE DIAGRAMS

9

Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron carbon system.

UNIT IV FAILURES OF MATERIALS

9

Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile brittle transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep. Generalized creep behavior. Stress and temperature effects.

UNIT V PROCESSING OF MATERIALS

9

Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics, Mechanical behavior of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types.

Polymer synthesis and processing, Particle reinforced composites. Fibre reinforced composites. Structural composites, Economic, Environmental and Social Issues of Material Usage. Recycling issues. Life cycle analysis and its use in design.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- demonstrate an understanding of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites
- understand existence of imperfections and their effects on mechanical properties of materials and cause of failure
- demonstrate understanding of phase diagrams and their use in predicting phase transformation and microstructure
- understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact
- know electrical, thermal, optical and magnetic properties of metals, ceramics, polymers and composites

REFERENCES

1. Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons, 07
2. Modern Physical Metallurgy and Material Engineering, Science, Process, application, Smallman R.E., Bishop R J, Butterworth Heinemann, Sixth Ed., 2010.

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CO5	3	2	2	-	-	-	-	-	-	-	-	2	3	2



COURSE OBJECTIVES

To enable the students to

- learn the significance and future enhancements in composite materials.
- analyze the geometric and physical properties of typical composite materials.
- understand the concepts of mathematical relations and mechanical properties.
- get knowledge in failure theories and strength parameters.
- design and analyze the structure and various laminates of composite materials.

UNIT I INTRODUCTION 9

Characteristics, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus

UNIT II BASIC CONCEPTS AND CHARACTERISTICS 9

Structural performance of conventional material, Geometric and physical definition, Material response, Classification of composite materials, Scale of analysis; Micromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials

UNIT III ELASTIC BEHAVIOR OF UNIDIRECTIONAL LAMINA 9

Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters

UNIT IV STRENGTH OF UNIDIRECTIONAL LAMINA 9

Micromechanics of failure; failure mechanisms, Macro-mechanical strength parameters, Macro mechanical failure theories, Applicability of various failure theories

UNIT V ELASTIC BEHAVIOR OF LAMINATE 9

Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates. Design for structural composite materials.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the basic concepts and difference between composite materials with conventional materials.
- understand role of constituent materials in defining the average properties and response of composite materials on macroscopic level.
- apply knowledge for finding failure envelopes and stress-strain plots of laminates.
- develop a clear understanding to utilize subject knowledge using
- computer programs to solve problems at structural level.

REFERENCES

1. Isaac M. Daniels, Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 1994.
2. Bhagwan D. Agarwal, Lawrence J. Broutman, "Analysis and Performance of fibercomposites", John Wiley and Sons, Inc. 1990.
3. Mathews, F. L. and Rawlings, R. D., "Composite Materials: Engineering and Science", CRC Press, Boca Raton, 03.
4. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press, 04.
5. Mazumdar S. K., "Composite Manufacturing – Materials, Product and Processing Engineering", CRC Press, Boca Raton, 02.

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



COURSE OBJECTIVES

To enable the students to

- develop a thorough understanding of the various mechanisms and its design and simulation with ability to effectively use the various mechanisms in real life problems.
- understand analytical working mechanism of curvature theory.
- apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.
- study basic of simple and complex mechanism analysis movement of planar and spherical four-bar linkages.
- think creatively and understand couple curve analysis and to present logical solutions.

UNIT I	INTRODUCTION	9
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Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.

UNIT II	PATH CURVATURE THEORY	9
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Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.

UNIT III	KINEMATIC ANALYSIS	9
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Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms.

UNIT IV	SYNTHESIS OF FOUR BAR MECHANISM	9
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Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.

UNIT V	SYNTHESIS OF COUPLER CURVE BASED MECHNISM.	9
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Coupler Curves : Equation of coupler curve, Robert-Chebyshev theorem, double points and symmetry.

TOTAL PERIODS	45
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COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- develop analytical equations describing the relative position, velocity and acceleration of all moving links.
- select, configure, and synthesize mechanical components into complete systems.
- use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
- formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
- analyze and animate the movement of planar and spherical four-bar linkages.

REFERENCES

1. R.S. Hartenberg and J. Denavit, “Kinematic Synthesis of Linkages”, McGraw-Hill, NewYork, 1980.
2. Robert L.Nortan, "Design of Machinery",Tata McGraw Hill Edition
3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons NewYork
4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York
5. A. Ghosh and A.K. Mallik, “Theory of Machines and Mechanisms”, Affiliated East-West Press, NewDelhi, 1988.

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



COURSE OBJECTIVES

To enable the students to

- study the concepts of mechatronics systems.
- acquire knowledge about the sensors and transducers.
- understand the working of the actuators.
- prepare the program and work on PLC.
- understand the working of CNC and micro controller.

UNIT I INTRODUCTION 9

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

UNIT II SENSORS AND TRANSDUCERS 9

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 9

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

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

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 9

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 PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- have exposure on mechatronics systems and overview of control systems & actuators.
- gain knowledge about the sensors and transducers and its applications.
- understood the working of various actuators and its applications.
- gain knowledge on various signal conditioning units in plc.
- understood the programming and working of cnc and micro controller.

REFERENCES

1. Bolton.W, “Mechatronics” , Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
3. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company,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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CO2	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO3	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO4	2	-	1	-	2	-	-	-	-	-	-	-	2	2
CO5	2	-	1	-	2	-	-	-	-	-	-	-	2	2



PROGRAMME ELECTIVE III

PED19351

TRIBOLOGY IN DESIGN

3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart the knowledge in friction and surface measurement
- basics of theories of wear and wear prevention
- understand the bearing material properties which influence the tribological characteristics of surfaces and lubricants
- students are able to design of bearings and types
- understand the analytical behavior of different types bearings and design of bearings based on analytical / theoretical approach

UNIT I FRICTION AND SURFACE MEASUREMENT 9

Friction, theories of friction, Friction control, Surface texture and measurement, genesis of friction, instabilities and stick-slip motion.

UNIT II WEAR 9

Wear, types of wear, theories of wear, wear prevention.

UNIT III BEARING MATERIALS AND LUBRICANTS 9

Tribological properties of bearing materials and lubricants.

UNIT IV BEARINGS 9

Lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings, Design of hydrodynamic journal bearings.

UNIT V THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICATION 9

Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, lubrication of spheres, gear teeth, Air lubricated bearings.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- the students will be able to understand theories of friction and surface measurement
- they will understand the theories of wear and prevention of wear
- they will be able to select materials and lubricants to suggest a tribological solution to a particular situation.

- the students will be able to design a bearing using various bearing charts.
- the students will be able to understand the hydrostatic and dynamic lubrication.

REFERENCES

1. Majumdar, B.C, “Introduction to Tribology of Bearings”, S.Chand, 2ndEdition, 2008
2. John Williams, “Engineering Tribology”, Cambridge University Press, 2006
3. S.K.Basu, S.N.Sengupta&B.B.Ahuja ,“Fundamentals of Tribology”, Prentice–Hall of India Pvt Ltd New Delhi.,2005
4. Sushil Kumar Srivastava, “Tribology in Industries”, S.Chand& Company Ltd, New Delhi.2001
5. G.W.Stachowiak& A.W .Batchelor , Engineering Tribology, Butterworth - Heinemann, UK, 2005

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	3	3	3	3	-	-	-	-	-	-	3	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	3	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	2	2



COURSE OBJECTIVES

To enable the students to

- learn the basic concepts of robot and its automation
- gain the depth knowledge of gripper and sensors
- familiarize the working principle of robot through various mechanical pneumatic drives and control systems
- understand the concepts of journal bearing , finite bearing
- study the various programming languages and the operating commands of robot

UNIT I INTRODUCTION**9**

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

UNIT II ROBOT GRIPPERS**9**

Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

UNIT III DRIVES AND CONTROL SYSTEMS**9**

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.

UNIT IV KINEMATICS**9**

Lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings, Design of hydrodynamic journal bearings

UNIT V MACHINE VISION SYSTEM**9**

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types

such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems. Artificial neural networks in manufacturing automation, Introduction to Artificial Intelligence techniques, socio- economic and safety aspect of robotisation and updates in robotics.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand basic terminologies and concepts associated with robotics and automation
- gain the knowledge of types of grippers and sensors
- demonstrate comprehensive of various robot subsystems\
- understand the kinematics and dynamics to explain the exact working pattern of robots
- aware of the robot languages associated recent updates of robots and its programming languages

REFERENCES

1. Richard D. Klafter , Thomas A. Chmielowski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.April 1989
2. Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons. September 1994
3. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04 ,2008
4. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.
5. Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co, Editon 02.March 1999

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	-	-	-	-	-	-	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



COURSE OBJECTIVES

To enable the students to

- introduce the basic concept of fracture mechanics and failure analysis
- know about the theoretical background of crack growth
- identify the stress /strain fracture characterizing parameters like stress intensity factor
- import knowledge on deformation fields near a crack tip
- learn the methods of estimating fracture toughness testing

UNIT I INTRODUCTION 9

Modes of fracture failure, Brittle and ductile fracture, fatigue failure, environment assisted cracking.

UNIT II CRACK GROWTH 9

Energy release rate: crack resistance, stable and unstable crack growth.

UNIT III STRESS ANALYSIS OF CRACKS 9

Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks.

UNIT IV CRACK TIP PLASTICITY 9

Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement.

UNIT V FRACTURE TOUGHNESS TESTING 9

Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral.

TOTAL PERIODS 45

COURSE OUTCOMES

upon the completion of the course, the students will be able to

- students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, j integral, crack tip opening displacement.
- students will be able to manage singularity at crack tip using complex variable.
- students will understand important role played by plastic zone at the crack tip.
- students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.
- students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

REFERENCES

1. Brook D, "Elementary engineering fracture mechanics"
2. Liebowitz H., "Fracture" Volume I to VII.
3. A Nadai, W. S. Hemp, "Theory of flow and fracture of solids", McGraw Hill Book Company, 1950.

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	3	3	2	2	-	-	-	-	-	-	2	2	2
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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



COURSE OBJECTIVES

To enable the students to

- introduce the basic concepts, tools, data management and integration process of re-engineering
- know different types of Reverse Engineering tools.
- study the reverse engineering concepts and their implementations.
- understand the strategies, software components and evaluation models of data management.
- 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

Upon the completion of the 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. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996

CO-PO Mapping

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CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2



PED16551	PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING	3	0	0	3
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- 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.

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

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

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

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

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

TOTAL PERIODS 45

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.
4. Premvrat, Sardana, G.D. and Sahay, B.S., “Productivity Management – A Systems Approach”, Narosa Publishing House. New Delhi, 1998.
5. Giles Johnston, “Business process Reengineering” 2017.

WEB LINKS

1. <http://ebookdig.biz/ebook/q/pdf/productivity-management-and-re-engineering.html>
2. <https://totalqualitymanagement.wordpress.com/.../productivity-quality-an>
3. https://en.wikipedia.org/wiki/Business_process_reengineering

CO-PO Mapping

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CO1	2	2	2	2	3	1	-	-	-	-	-	2	1	2
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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



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.

REFERENCES

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 Wiley 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.

WEB LINKS

1. www.vgu.edu.vn/fileadmin/pictures/studies/master/.../tp/plastice.pdf
2. web.itu.edu.tr/~livatyali/dersler/mak645e/ICTP08_history.pdf
3. www.ntnu.edu/studies/courses/TMT4266

CO-PO Mapping

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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



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.

WEB LINKS

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



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

- nptel.ac.in/courses/112107142/part2/material%20handling/lecture1.htm
- 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
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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
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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
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Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT III	HYDRAULIC CIRCUITS	5
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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
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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
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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
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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 Esposito, “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).

WEB LINKS

1. nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
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



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.

WEB LINKS

1. nptel.ac.in/courses/105105041/module%206.pd
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														
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

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

WEB LINKS

1. https://www.mersen.com/uploads/tx_mersen/brochure-pressure-vessels_1_.pdf
2. <http://strathprints.strath.ac.uk/7495/>
3. ed.iitm.ac.in/course/design-of-heat-exchangers-pressure-vessels-and-piping/

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



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

UNIT III MOBILITY MEASUREMENT TECHNIQUES**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 System Models .

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.

- 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
5. Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”,Wiley John & sons, 1998.

WEB LINKS

1. nptel.ac.in/syllabus/syllabus.php?subjectId=112105055.
2. www.springer.com/gp/book/9783709117903
3. <https://hal.inria.fr/docs/00/56/17/57/PDF/paper.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	2	2	2	-	-	-	-	-	-	-	-	2	2	2
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CO3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2	2



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
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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



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 the identified 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/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
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CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

