P14DE101 OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *To enable the student to acquire mathematical methods and apply in engineering disciplines.*
- *To introduce the methods of optimization to solve a linear programming problem by various methods.*
- *To introduce the techniques of solving a Non- linear programming problem with / without constraints.*
- *To introduce few advanced optimization techniques.*

UNIT-I (9+3)

Introduction: Classification of optimization problems, mathematical models in engineering optimization. Concepts in linear optimization: General simplex method, revised simplex method, duality, decomposition principle, integer programming, branch and bound technique and the Gomory algorithm, post optimality analysis.

UNIT-II (9+3)

Non linear programming without constraints: Local and global maxima, minima, Hessian matrix, Fibonacci method, Golden section method, random search method, steepest descent method and conjugate gradient method.

UNIT-III (9+3)

Non linear programming with constraints: Lagrange multipliers, Kuhn-Tucker conditions, quadratic programming. Wolfe's and Beale's method, sequential linear programming approach, penalty methods. Interior and exterior penalty function method.

UNIT-IV(9+3)

Advanced optimization techniques: Concepts of multi-objective optimization, genetic algorithms and simulated annealing.

Text Books:

1. S.S.Rao, *Optimization-Theory and Applications, ,* Wiley Eastern, New Delhi, 1978
2. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983
3. Kanthi Swaroop, et.at., *Operations Research,* S. Chand & Co., New Delhi,
4. Kalyanmoy Deb, *Optimization for Engineering Design Algorithms and Examples,* Prentice Hall of India, New Delhi, 1995
5. Kalyanmoy Deb, *Mulitobjective Optimization –An evolutionary Algorithmic Approcach,* John Wiley & Sons, New York.

<u>Reference Books</u>:

1. J.S. Arora, Introduction to optimum design, McGraw Hill, New York, 1989
2. R.L. Fox, Optimization Methods for Engineering Design, Addison Wesley, New York, 1971.
3. D.E. Goldberg, Genetic Algorithms in Search, Optimization and Machine, Barnen, Addison Wesley, New York, 1989.

Course Learning Outcomes:

After completion of the course, the student will be able to

- *Solve the given linear programming problem by simplex/revised simplex method.*
- *Solve an integer programming problem using various techniques.*
- *Solve a non-linear programming problem without constraints by random search methods as well as steepest-descent method and conjugate gradient methods.*
- *Solve a non-linear programming problem with constraints using Kuhn-Tucker conditions.*
- *Understand the concept of Multi-objective optimization and use of genetic algorithms and simulated annealing.*

P14DE102 STRESS ANALYSIS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *To identify the likely locations of highest stress of a loaded beam, shaft, or tension member*
- *To use concepts of stress and strain to estimate stress and strain in engineering problems*
- *To determine the principal stresses and strains from the known stresses at a point*
- *To perform stress transformations in plane stress loading and apply Mohr's circle*
- *To evaluate stresses at a point on an object subject to arbitrary loading*
- *To perform stress analysis using Energy Principles and Variation Methods.*

UNIT-I (9+3)

Analysis of Stress& Strain: Definition and notation of stress, Differential equations of equilibrium, specification of stress at a point, Principal stresses and the Mohr Diagram, three dimensional stress at a point, Boundary conditions in terms of given surface forces. Strain components, Specification of strain at a point, Compatibility equations, three-dimensional strains, Mohr's circle for strains, Measurement of strains bonded strain gages.

UNIT-II (9+3)

Stress-Strain Relations and the General Equations of Elasticity: Idealization of Engineering Materials, Generalized Hooke's law, Elastic symmetry, Generalized Hooke's law in terms of Engineering elastic constants, Strain energy, Saint-Venant's principle.

UNIT-III (9+3)

Plane-Stress and Plane-Strain Problems: The governing differential equations, Thick cylinder under uniform pressure, shrink and force fits. The effect of small circular holes in strained plates, Stress concentration **Thermal Stresses:** Thermoelastic stress-strain relations,

UNIT-IV (9+3)

Energy Principles and Variational Methods: Principle of Potential energy, Principle of complementary energy. Rayleigh-Ritz method, Galerkin method. Reciprocal Theorem and Castigliano's Theorems.

Text Books:

1. C.T. Wang, *Applied Elasticity,* McGraw-Hill, New York, 1953.

Reference Books:

1. A.C.Ugural and S.K. Fenster, *Advanced Strength and Applied Elasticity, 3/e* PTR Prentice Hall, Englewood Cliffs, New Jersey, 1995.
2. G.E.Dieter, *Mechanical Metallurgy,* McGraw-Hill Book Company, Singapore, 1988.
3. S.P.Timoshenko and J.N.Goodier, *Theory of Elasticity,* 3/e, McGraw-Hill, New York, 1985.

Course Learning Outcomes:

After completion of the course, the student will be able to

- *understand the behavior of a material under various kinds of static loadings, i.e., axial loading, bending moment, torsional loading and transverse loading etc.*
- *analyze the problems related to mechanics of materials and find the stress and deformation of the components under static loadings and cyclic loads.*
- *perform the stress analysis based on various Energy Principles and Variational Methods.*

P14DE103 MECHANICAL VIBRATIONS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,*
- *be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF),*
- *be able to write the differential equation of motion of vibratory systems,*
- *be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.*

UNIT-I (9+3)

1. **Fundamental of Vibration:** Review of Single degree freedom systems – Response to arbitrary periodic Executions – Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration – Laplace transformation formulation.

UNIT-II(9+3)

2. **Two Degree Freedom System:** Free vibration of spring-coupled system – mass coupled system – Bending vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

UNIT-III (9+3)

3. **Multi-Degree Freedom System:** Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – orthogonal properties – Modal matrix – Modal Analysis – Forced Vibration by matrix inversion – Model damping in forced vibration – Numerical methods for fundamental frequencies.

UNIT-IV (9+3)

4. **Experimental methods in Vibration Analysis:** Vibration instruments– Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

Text Books:

1. Rao, S.S., *Mechanical Vibrations*, Addison Wesley Longman.
2. R.Venkata Chalam, *Mechanical Vibrations, Prentice hall, India.*

Reference Books:

1. William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications*, *5/e,* Pearson Education, Singapore, 2003.
2. Meirovich, L. *Elements of Vibration Analysis*, McGraw-Hill, New York, 1986,
3. S. Graham Kelly, *Fundamentals of Mechanical Vibrations, 2/e*, McGraw-Hill, Singapore, 2000.
4. Den Hartog, J.P., *Mechanical Vibrations*, Dover Publications, 1990.

Course Learning Outcomes:

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

- *Understand the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.*
- *Analyze the mathematical model of a linear vibratory system to determine its response.*
- *Create linear mathematical models of real life engineering systems.*
- *Use Lagrange's equations for linear and nonlinear vibratory systems.*
- *Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.*

P14DE104 COMPUTER AIDED ENGINEERING DESIGN

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *to know the main concepts of computer aided design: solid modeling, assembly design, engineering drawing conventions, dimensioning and tolerance specification and descriptive geometry.*
- *to learn conceptual design skills such as creative thinking and idea illustration by sketching.*
- *to perform different manipulations on CAD Designs with the knowledge of transformation*
- *to learn synthetic curves and surfaces, their properties and application*

UNIT I (9+3)

CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

GEOMETRIC MODELLING: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves

UNIT II (9+3)

SURFACE MODELING: Mathematical representation surfaces, Surface model, Surface entities surface representation, parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT III (9+3)

PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES –Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

GEOMETRIC MODELLING-3D: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

UNIT IV (9+3)

CAD/CAM data Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

DESIGN APPLICATIONS: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly. Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems.

Reference Books:

1. CAD/CAM Theory and Practice / Ibrhim Zeid / Mc Graw Hill international.
2. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill international.
3. CAD/CAM / P.N.Rao / TMH.
4. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
5. Concurrent Engineering Fundamentals: Integrated Product Development/ Prasad / Prentice Hall.
6. Successful Implementation of Concurrent Product and Process / Sammy G Sinha / Wiley, John and Sons Inc.

Course Learning Outcomes:

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

- *Learn the basic principles of computer aided design, Different transformations and projections, Characteristics and applications of curves and surfaces, Graphics standards and data base models.*

P14DE105A PRINCIPLES OF PRODUCT DESIGN

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *to understand the design process*
- *to apply the design concept generation and evaluation*
- *to develop Engineering specifications*
- *to understand Importance and goals of Performance evaluation*

UNIT-I (9+3)

Design Process: Describing mechanical design problems and processes – Types of mechanical design problems, Languages of mechanical design, constraints, goals and design decisions, Designers and design teams. Planning of design process: overview of the design processes, organization techniques, developing design project plans, steps in planning, case studies

UNIT-II (9+3)

Design concept generation and evaluation: Technique for functional decomposition, generating and developing concepts, evaluation based on feasibility judgment, technology – readiness assessment, Go/No go screening, decision matrix.

UNIT-III (9+3)

Development of Engineering specifications: Steps in development of engineering specification, identification of customer\s requirements, quality functional deployment (QFD),

UNIT-IV (9+3)

Product Evaluation: Importance and goals of Performance evaluation, robust design, sensitivity analysis, cost estimation in design, design for reliability, environment and maintenance

Text Books:

1 David G. Ullma, "The Mechanical Design Process", McGraw Hill, 1955.
2 George E. Dieter, "Engineering Design",

Reference Books:

1. E.N.Baldwin and B.W. Niebel, , *Designing for Production,* Homewood, Illinois, 1975.
2. J.C.Jones, *Design Methods, Seeds of Human Futures,* John Wiley, New York, 1978.
3. J.G.Bralla, *Handbook of Product Design for Manufacture,* McGraw-Hill, New York, 1988.

Course Learning Outcomes:

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

- Identify project constraints and solutions, problem decomposition, requirements elicitation, design trade-off analysis.
- Preparation of documentation and presentations; making presentations; participating in team meetings, brainstorming session, code reviews and walkthroughs, or artifact reviews; customer or project sponsor interactions; use of discussion forums.
- Know Feasibility analysis, environmental impact analysis, support for different languages, and usability analysis for people with impairments.
- Use process methodologies, design methodologies, development tools.

P14DE105B DESIGN FOR MANUFACTURE & ASSEMBLY

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *to identify key features of a production line process and how it can be made more effective*
- *to monitor a simulated process and identify skills needed to make it work efficiently*
- *to understand concepts such as 'Just in Time manufacturing' and 'Lean manufacturing' and apply them to the process.*

UNIT-I (9+3)

INTRODUCTION TO DESIGN FOR MANUFACTURE (DFM): Design Concepts considerations like part count, product weight, manufacturing costs assembly time etc., concurrent engineering – definition and concepts, improving competitiveness with concurrent engineering, implementation methodologies.

UNIT-II (9+3)

MATERIALS AND PROCESSES: Material selection and its inter relationship with process selection, comparison of various processes for productivity and produce-ability machining process, casting processes, deformation processes.

UNIT-III (9+3)

GENERAL CONSIDERATIONS IN DFM: Performance considerations, Manufacturability considerations, Testability consideration, Serviceability considerations, Computer aided engineering and testing.

UNIT-IV (9+3)

IMPLEMENTATION TECHNIQUES OF DFM: Manufacturability evaluation methods, principles and rules for product design, Quantitative evaluation methods, Boothroyd and Dewhurst DFA method, Methodology for planning experiments in robust product and process design, Redesigning mature products for competitiveness. Designing for CNC manufacture knowledge based solutions for assembly problems, Linking manufacturing and product life cycles.

Text Books:

1 John Cobert et. "Design for Manufacture – Strategirs, Principles and Techniques", Addison Wesley Pub.Co.,.
2 John Turino, "Managing Concurrent Engineering "Von Nostrand Reinhold, New York, .
3 George E. Dieter, "Engineering Design – A material processing approach", McGraw International, .
4 BUTHROID
5 DEGARMAN

Course Learning Outcomes:
After completion of the course, the student will be able to

- *Identify how a production line can be run efficiently*
- *Reflect upon the critical skills and evaluate their own performance*
- *Relate concepts such as 'Just in Time manufacturing' and 'Lean manufacturing' to the context of an assembly line*

P14DE105C RAPID PROTOTYPING TECHNIQUES

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *To describe the principles embedded into the basis of Rapid Prototyping (RP).*
- *To acquaint students with the basic kinds of RP-systems.*
- *To show the progress in RP-technology in the context of shortening lead-time for new production.*
- *To consider the concept of Rapid Tooling (RT), to show its current and prospective application.*
- *To discuss the concept of Rapid Manufacturing in terms of its potential applicability, practicability, and expedience.*

UNIT I (9+3)

Introduction: Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Automated Processes, Process Chain.

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

UNIT II (9+3)

Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT III (9+3)

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods, Direct Rapid Tooling.

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats, Features of various RP softwares.

UNIT IV (9+3)

RP Applications: Application – Material Relationship, Application in Design , Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Books:

1 Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.

Reference Books:

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer .
2. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press.

Course Learning Outcomes:

Upon completion of the subject, students will be able to

- *select and apply appropriate tools and techniques in Rapid Prototyping;*
- *know the Rapid Prototyping principles.*
- *get acquainted with the basic kinds of RP-systems*
- *understand the progress in RP-technology in the context of shortening lead-time for new production.*
- *appreciate the concept of Rapid Manufacturing in terms of its potential applicability, practicability, and expedience.*

P14DE105D DESIGN OF EXPERIMENTS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- Get the knowledge about various types of experiments that are frequently employed in industries for experimental studies.
- Plan, design and conduct experiments efficiently and effectively.
- Be well able to Analyze and interpret the experimental data obtained through designed experiments.
- Be able to compare classical designs, orthogonal arrays and response surface methods.

UNIT – I (9+3)

Introduction to research methodology, The economics of reducing variation, quality characteristics and objective functions, Taguchi quality loss function, DOE process – steps and description, Typical test strategies, Better test strategies- full factorial experiments, fractional factorial experiments, standard orthogonal arrays and linear graphs.

UNIT – II (9+3)

Construction of orthogonal arrays and modification of linear graphs. Introduction to analysis of variance (ANOVA) – analogy with Fourier analysis, No way ANOVA, one way ANOVA, two way ANOVA, three way ANOVA, signal to noise (S/N) ratio, sum of squares, degrees of freedom, F-test, p-value, pooling, percent contribution, interpretation, examples on ANOVA.

UNIT – III (9+3)

Control factors and their levels and noise factors. Two level experiments (2^K design), blocking and confounding, three level experiments (3^K design), mixed level experiments, multiple level experiments, polynomial effects, confirmation experiments, additive models, Latin squares and related designs, case studies.

UNIT – IV (9+3)

Response surface methodology (RSM) – First order model, second order model, stationary point, central composite design (CCD), Box-Behnken design, Face centered cubic design (FCCD), surface plots. Fitting regression models, model building, adequacy checking of models and case studies.

Textbooks

1. M. S. Phadake, *Quality Engineering and Robust Design*, Prentice Hall, Englewood Cliffs, New Jersy, 1989.
2. D. C. Montgomery, *Design and analysis of experiment*, Wiley, 5th edition, India, 2005.

Reference books

1. P.J. Ross, *Taguchi Techniques for quality engineering*, Tata Mc-Graw Hill, 2nd edition, 2005.

Course Learning Outcomes:

Upon completion of the subject, students will be able to

- Understand the various types of designs of experiments.
- Selection of the proper design of experiments that suits the application
- Select control factors, their levels, noise factors and objective functions.
- Learn adjustments and modifications in standard design of experiments.

P14DE106A DESIGN OF HEAT TRANSFER EQUIPMENT

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *to be familiar with the major types of available heat-exchange equipment, with particular emphasis on shell-and-tube heat exchangers.*
- *to know how to estimate overall heat transfer coefficients for a shell-and-tube heat exchanger.*
- *to know how to compute pressure drops on both sides of a shell-and-tube heat exchanger.*
- *to be able to perform mechanical design of the most appropriate shell-and-tube heat exchanger to meet desired duty and pressure drops.*

UNIT I (9+3)

Design of Heat Exchangers: Principle, Classification – Applications - Principle of Heat Exchangers. Concept of Overall Heat Transfer Coefficient - Derivation of the concerned equations, Fouling, Factors effecting fouling.

Concept of Logarithmic Mean Temperature Difference: Derivation for expression for the LMTD, Special Cases, LMTD for a single-pass cross-flow heat exchanger, AMTD, Relation between AMTD and LMTD.

UNIT II (9+3)

Concept of Effectiveness: Effectiveness-Number of Transfer Units, Expressions for effectiveness of single-pass parallel-flow and counter-flow heat exchangers, Heat capacity ratio, Chart solutions of Kays and London pertaining to Effectiveness-NTU approach.

Design of Condensers: Types , Overall Heat Transfer coefficients – temperature distribution and heat flow in a condenser – pressure drop in a condenser – extended fin surfaces – consideration of fouling factor – LMTD – Correction Factor.

UNIT III (9+3)

Design of Evaporators: Types - Temperature distribution and heat flow in an evaporator - pressure drop – factors to be considered in the design of heat transfer equipment – types of heat consideration of fouling factor.

Design of Compressors: Types – equivalent shaft work – volumetric efficiency – factors effecting total volumetric efficiency compound compression with inter cooling –rotary compressors.

UNIT IV (9+3)

Design of Cooling Tower and Spray Ponds: Classification – performance of cooling towers – analysis of counter flow cooling towers – enthalpy – temperature diagram of air and water. Cooling ponds – types –cross flow cooling towers – procedure for calculation of outlet conditions

Text Books:

1. Sadik Kakac and Yaman Yener: Heat Conduction, Hemisphere,
2. Kays, W. M. and Crawford, M. E., Convective Heat and Mass Transfer, Tata McGraw Hill, 4th Edition, 2012.
3. Siegel, R. and Howell, J. R., Thermal Radiation Heat Transfer, Taylor and Francis

Course Learning Outcomes:

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

- *Be familiar with the major types of available heat-exchange equipment, with particular emphasis on shell-and- tube heat exchangers.*
- *Know how to estimate overall heat transfer coefficients, including the effect of fouling.*
- *Be able to perform mechanical design of the most appropriate shell-and-tube heat exchanger to meet desired duty and pressure drops.*

P14DE106B COMPUTATIONAL FLUID DYNAMICS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *to develop an understanding of the major theories, approaches and methodologies used in CFD;*
- *to build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes;*
- *to gain experience in the application of CFD analysis to real engineering designs.*

UNIT-I (9+3)

Introduction to CFD: Definition, applications, advantages, limitations and future scope of CFD.

CFD Solution Procedure: Creation of geometry; meshing; specification of fluid properties; specification of boundary conditions; numerical solution – initialization, solution control and convergence.

UNIT-II (9+3)

Governing Equations: Substantial derivative; divergence; continuity equation for - finite control volume fixed in space and moving with the fluid, infinitesimally small element fixed in space and element moving with the flow; momentum equation; energy equation; Navier-Stokes equations; Euler's equations; types of physical boundaries and corresponding conditions;

UNIT-III (9+3)

Turbulence: Definition of turbulence; its source; its impact on solution methodology, k-ε two equation model, limitations of turbulence models.

Classification of PDEs – Hyperbolic, parabolic and elliptic equations; mathematical behavior of PDEs.

UNIT-IV (9+3)

Discretization: Introduction to finite difference; finite difference equations, explicit and implicit formulations; consistency; error and stability analysis - von Neumann approach; convergence; Finite difference and Finite volume approach, Direct Numerical Approach.

Reference Books:

1. Computational Fluid Dynamics: The Basics with Applications, John D. Anderson, Jr., McGraw-Hill.
2. Computational Fluid Dynamics: Klaus A. Hoffmann, Steve T. Chiang, Engineering Education System; 4th edition
3. Numerical Heat Transfer and Fluid Flow: Suhas Patankar, Hemisphere Publishing Corporation.

Course Learning Outcomes:

After completion of this course the student should be:

- *familiar with the differential equations for flow phenomena and numerical methods for their solution*
- *Able to use and develop flow simulation software for the most important classes of flows in engineering and science.*
- *able to critically analyze different mathematical models and computational methods for flow simulations*
- *Able undertake flow computations using current best practice for model and method selection, and assessment of the quality of results obtained.*

P14DE106C HVAC SYSTEMS & APPLICATIONS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:
On completion of this course, students should be able:

1. *To learn principles of thermodynamics, heat transfer and fluid mechanics as applied to heating, ventilating and air-conditioning (HVAC) systems.*
2. *To do problem formulation and solution methods for HVAC systems.*
3. *To learn HVAC application specific principles such as indoor air quality, human thermal comfort, passive solar gains, and building energy storage.*
4. *To get exposed to common engineering design aids such as psychometric charts, comfort charts, building materials property data and weather data.*
5. *To get exposed to realistic HVAC problems through examples and assignments.*
6. *To get exposed to examples of software, such as EES, that are useful in analyzing psychometric systems*

UNIT I (9+3)

Introduction - Purpose, applications, definition and components of air conditioning - Need and methods of ventilation - Course outline.
Psychrometry - Evolution of air properties and psychrometric chart - Basic processes such as sensible heating/cooling, humidification/dehumidification and their combinations, steam and adiabatic humidification, adiabatic mixing - Bypass factor and Sensible heat ratio.
AC Equipments - Air washer, adiabatic, heated and cooled - Cooling tower, enthalpy potential, types, tower efficiency.

UNIT II (9+3)

Summer and Winter AC - Simple summer AC process, Room sensible heat factor, Coil sensible heat factor, ADP - Precision AC - Winter AC.
Human Comfort - Heat transfer from body - Concept of human comfort - Thermal response - comfort factors.

UNIT III (9+3)

Cooling Load Estimation - Design conditions, outdoor, indoor - External load, wall, roof, glass - Internal load, occupancy, lighting, equipments - Ventilation, air quantity, loads - Load estimation methods

UNIT IV (9+3)

Ventilation - Need, threshold limits of contaminants, estimation of ventilation rates, decay equation, air flow round buildings. Methods of Ventilation.
Ventilation System Design: Exhaust ducts, Filters, Blowers, Hoods, Chimney.

Text Books:

1. Heating, Ventilating and Air Conditioning, Analysis and Design, by F.C. McQuiston & J.D. Parker, 2nd ed., John Wiley & Sons, Inc., .
2. Refrigeration and Air conditioning: Arora, C.P., Tata McGraw-Hill Education.

Reference Books:

1. Refrigeration and Air conditioning: Arora S C, Domkundwar S, Pearson Education Canada.
2. Refrigeration and Air Conditioning: Stoecker, W. F., and Jones, J. W., McGraw Hill.
3. Refrigeration and Air Conditioning: Manohar Prasad, New Age International Publishers.

Course Learning Outcomes:

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

- *Apply the principles of thermodynamics to mixtures of water vapor and dry-air to establish psychrometric properties.*
- *Apply the principles of conservation of mass and energy to define and quantify basic HVAC processes.*
- *To combine basic HVAC processes into various building mechanical systems used in current practice. To understand and be able to evaluate the performance of heat pumps and modes of operation such as defrosting.*
- *Apply basic heat transfer principles to determine building heating and cooling loads.*
- *Apply ASHRAE Standard 62 to achieve acceptable indoor air quality for human thermal comfort, health and safety.*
- *Select and interpret information (e.g. materials properties, weather data, solar radiation data, internal gains, etc.) required for design and analysis of building loads and mechanical systems.*
- *Apply ASHRAE recommended design practice and applicable building codes to the design of building mechanical systems.*

P14DE106D ADVANCED FLUID MECHANICS

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme: **Examination Scheme:**

L	T	P	C		Continuous Internal Evaluation:	40 marks
3	1	-	4		End Semester Exam :	60 marks

Course Learning Objectives:

- *to understand and apply the differential equations of fluid mechanics and understand the impact of assumptions made in the analysis.*
- *to understand and apply the potential flow equations to basic flows.*
- *to understand and apply the compressible flow equations.*
- *to perform a computational fluid dynamics analysis.*

UNIT I (9+3)

Basic Concepts and Fundamentals, Definition and properties of Fluids, Velocity and stress field, Fluid statics, Fluid Kinematics.

Governing Equations of Fluid Motion, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation.

UNIT II(9+3)

Exact solutions of Navier-Stokes Equations: Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows.

Laminar Boundary Layers: Boundary layer equations, Boundary layer thickness, on a flat plate, Integral form of boundary layer equations, Approximate Methods.

UNIT III (9+3)

Turbulent Flow: General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtl mixing hypothesis, Turbulence modeling, Free turbulent flows

UNIT IV (9+3)

Compressible Flows: Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Quasi-one dimensional flows, Compressible viscous flows, Compressible boundary layers

Reference Books:

1. Fundamentals of Fluid Mechanics; Bruce R. Munson, Alric P. Rothmayer, Theodore H. Okiishi: John Wiley & Sons, 7th Edition
2. Fluid Mechanics; A..Mohanty, PHI Learning Pvt. Ltd., 2nd Edition.
3. Theory Appl Fluid Mechanics; K. Subramanyan, Tata Mcgraw-Hill Publishing Company Limited, 1993

Course Learning Outcomes:

At the conclusion of this subject the student would -

- *Understand the limitations and advantages of various experimental techniques for fluid mechanics, and also have a sound understanding of the physics underpinning these techniques*
- *Apply contemporary data analysis techniques in the area of fluid mechanics, especially relating to boundary layers and turbulence*
- *Understand how the equations of fluid motion are applied in various lubrication phenomenon*
- *Understand the importance of the boundary layer in engineering applications*
- *Understand the role of turbulence in various lubrication phenomenon.*

P14DE107 MECHANICAL VIBRATIONS LAB

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

LIST OF EXPERIMENTS

PART –A

1 Determination of Radius of Gyration of giver Bar by using Bi-fillar suspension.
2 Study of undamped free vibrations of equivalent spring mass system
3 Study of Forced vibrations of equivalent spring mass system
4 Study of free vibrations of two rotor shaft system.
5 Study of damped Torsional oscillations.
6 Verification of Dunkerlay's rule.

PART –B

7 To Plot the resulting motion of a mass subjected to two harmonic motions & identify the Beat Frequency.
8 To Plot the time variations of the displacement, velocity & acceleration of the mass in a given spring mass system.
9 To find & plot the free vibration response of a viscously damped system.
10 To find & plot the steady state response of a viscously damped system under harmonic force.
11 To plot the impulse response of a single degree of freedom structure due to a single impact.
12 To plot the impulse response of a single degree of freedom structure due to a single impact.

Exercises from Part B will be solved using MATLAB or C++ during regular class work in each week.

Text Books:

1. Rao, S.S., *Mechanical Vibrations*, Addison Wesley Longman, 1995.

Reference Books:

1. William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications*, *5/e,* Pearson Education, Singapore, 2003.
2 Meirovich, L. *Elements of Vibration Analysis*, McGraw-Hill, New York,
3 .S. Graham Kelly, *Fundamentals of Mechanical Vibrations, 2/e*, McGraw-Hill, Singapore,
4 Den Hartog, J.P., *Mechanical Vibrations*, Dover Publications,

P14DE108 C A D LABORATORY

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

LIST OF EXPERIMENTS

PART –A

2-D and 3-D modelling using AutoCAD, ProE/CATIA

1. 2-D drawing generation.
2. Layout as per standard.
3. Simple 3 D geometry creation.
4. Complex 3 D generation with Boolean operations.
5. Viewports-Named viewports.
6. Project Work.

PART-B

1. Implementation of Bresenham's Line Algortihm using C / C++
2. Implementation of Bresenham's Circel Algorithm using C / C++
3. Cubic Spline generation using C / C++

Reference Books:

1. AutoCAD 2000, BPB Publications.
2. Learners Manual AutoCAD.

P14DE109 SEMINAR

Class: M.Tech. I Semester **Branch**: Design Engg

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Exam :	-

- There shall be only Continuous Internal Evaluation (CIE) for Seminar, which includes Report Submission & Presentation
- A teacher will be allotted to a student for guiding in
  - (i) selection of topic
  - (ii) report writing
  - (iii) Presentation (PPT) before the DPGRC constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and Three to five other faculty members representing various specializations in that particular programme as members.

P14DE201 ADVANCED FINITE ELEMENT ANALYSIS

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *to know basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.*
- *to learn the use of finite element methods in engineering problem-solving drawing from applications in solid mechanics, fluid mechanics, heat transfer, and electromagnetism.*
- *to get familiarized with professional-level finite element software.*

UNIT-I (9+3)

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements, Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: one dimensional fin,

UNIT – II (9+3)

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT – III (9+3)

Two dimensional problems: complete and incomplete interpolation functions, Pascal's triangle. CST, LST, four noded and eight noded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two dimensional fin. Convergence: Requirements for convergence, h-refinement and p-refinement

UNIT – IV (9+3)

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

Text Books:

1. Harold C. Martin, *Introduction to Matrix Methods of Structural Analysis*, McGraw Hill, New York,
2. Robert D. Cook, David S. Malkus, Michel E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, 4/e, John Wiley & Sons, Singapore, 2003.

Reference Books:

1. P. Seshu, *Text Book of Finite Element Analysis,* Prentice Hall of India, New Delhi, 2003.
2. S. Rajasekaran, *Finite Element Analysis in Engineering Design,* S. Chand & Co., New Delhi, 2003.
3. Finite element methods by Chandrubatla & Belagondu.
4. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press
5. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill
6. J. N. Oden, Finite Element of Nonlinear continua, McGraw-Hill, New York
7. K. J. Bathe, Finite element procedures, Prentice-Hall

Course Learning Outcomes:

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

- *Derive integral statements for linear partial differential equations, such as the Laplace/Poisson equation, the wave equation, and the elasticity equations.*
- *Use integral statement to deduce finite element approximations for the underlying linear partial differential equations.*
- *Assess the accuracy and reliability of finite element solutions and troubleshoot problems arising from errors in a given finite element analysis.*

P14DE202 COMPOSITE MATERIALS

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

***Course Learning Objectives*:**

- *An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.*
- *An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.*
- *An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.*
- *An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties and find residual stresses from curing and moisture.*
- *An ability to predict the failure strength of a laminated composite plate Knowledge of issues in fracture of composites and environmental degradation of composites.*
- *An exposure to recent developments in composites, including metal and ceramic matrix composites.*
- *An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.*

UNIT-I (9+3)

Introduction to Composite Materials Constituents, Material forms Processing, Applications Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices.

UNIT-II (9+3)

Macro mechanical and Micromechanical behavior of a lamina, 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.

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

UNIT-III (9+3)

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

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

UNIT-IV (9+3)

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

Delamination, Matrix Cracking, and Durability, Inter laminar stresses, Edge effects, Fatigue and fracture, Environmental effects, Introduction to design of composite structures.

Reference Books:

1. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo.
2. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York.
3. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill.
4. Mechanics of Composite Materials, Autar K. Kaw, 2nd ed., CRC Press.
5. Engineering Mechanics of Composite Materials, I. M. Daniel, O. Ishai, Oxford University Press.

Course Learning Outcomes:

Upon completion of the subject, students will be able:

- *To give a thorough treatment of the classification and properties of composite materials, of the different ways composites can be laid up and how they can be analyzed, with emphasis on physical understanding.*
- *To perform independent analyses. The use of composite materials is increasing in many fields e.g. in transportation (sea, land, air, space), the oil industry, civil engineering construction, sports equipment, biomechanics and medicine*

P14DE203 ADVANCED DESIGN OF MACHINE COMPONENTS

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *Formulate and analyze stresses and strains in machine elements and structures subjected to various loads.*
- *Do tolerance analysis and specify appropriate tolerances for machine design applications.*
- *Apply multidimensional static failure criteria in the analysis and design of mechanical components.*

UNIT-IV (9+3)

Introduction to Advances in Mechanical Engineering Design. Review of materials & processes for design of machine elements.

UNIT-IV (9+3)

Static strength failure analysis -theories of failure, High cycle and low cycle fatigue design of shafting and gears, design of rolling contact bearings.

UNIT-IV (9+3)

Design for creep. Combined creep and fatigue failure prevention. Design to prevent buckling and instability, Design of sliding bearings Study of lubrication systems.

UNIT-IV (9+3)

Design for corrosion, wear, Design of Brakes, Clutches, springs. Aesthetic and ergonomic consideration in design of products**.**

Reference Books:

1. Norton L. R., “Machine Design – An Integrated Approach” Pearson Education, 2005
2. Fundamentals of Machine Component Design Robert C. Juvinall, Kurt M. Marshek, John Wiley & Sons
3. Maitra G.M., “Hand Book of Gear Design”, Tata McGraw Hill
4. Joseph E. Shigley, Charles R. Mischke, Richard G. Budynas, “Mechanical Engineering Design”, McGraw Hill, 2004.
5. P.S.G. Tech., “Design Data Book”, Coimbatore, 2003.

Course Learning Outcomes:

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

- *analyze and design structural joints.*
- *to analyze and design power transmission shafts carrying various elements with geometrical features.*
- *analyze and design mechanical springs.*
- *acquainted with standards, safety, reliability, importance of dimensional parameters and Tribological aspects in mechanical design.*

P14DE204 AUTOMATION AND ROBOTICS

Class: M. Tech. II Semester Branch: Design Engg.

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:
- *To acquire the knowledge on advanced algebraic tools for the description of motion.*
- *To develop the ability to analyze and design the motion for articulated systems.*
- *To develop an ability to use software tools for analysis and design of robotic systems.*

UNIT-I (9+3)

Manufacturing Automation: Introduction, Types of automations, automation strategies. Automated flow lines and automated assembly systems. Automated Material Handling and Storage system: Conveyors, AGVs, AS/RS and identification & data collections systems.

UNIT-II (9+3)

Automated Manufacturing Systems: Introduction to NC, CNC & DNC and Adaptive control. Programmable Logic Controllers: logic control and sequencing elements. Automated Inspection Systems: CMM, Machine Vision, flexible inspection systems.

UNIT-III (9+3)

Basic concepts in robotics: classification of robotics, Drives and control system for robotics, Robot work cell design and applications**.** Robot arm kinematics: Direct kinematics, transformation matrices for rotations, combined rotations, Denavit -Hartenberg representation.

UNIT-IV (9+3)

Control of robot manipulators: control of robot arm, computed torque technique, feed back control, resolved motion control. Robot vision and sensing: Different types of sensors, proximity, touch, force and torque sensors, low level and high level vision, vision systems

Text Books:
1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, *Robotics*, McGraw Hill, 1987.
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manfucaturing", PHI, New Delhi.

Reference Books:
1. Y.Koren, *Robotics for Engineers,* McGraw Hill, 1985.
2. J.J. Craig, *Robotics,* Addison-Wesley, 1986.

Course Learning Outcomes:

Upon completion of the subject, students will be able to:
- *use matrix algebra for computing the kinematics of robots.*
- *calculate the forward kinematics and inverse kinematics of serial and parallel robots.*
- *calculate the Jacobian for serial and parallel robot.*
- *do the path planning for a robotic system.*

P14DE205A FAULT DIAGNOSIS OF MACHINES

P14DE205A FAULT DIAGNOSIS OF MACHINES

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *Set up a preventive maintenance program.*
- *Know about instrumentation for recording and analysis in vibrations.*
- *Learn detailed diagnostic monitoring.*

UNIT-I (9+3)

Introduction: System failure, component failure, failure decisions, failure classifications, types of failure, failure investigations, causes of failure, Various methods of maintenance

Condition Monitoring: Need and importance of condition monitoring, common monitoring techniques, online/off-line monitoring, commonly measured operating characteristics, condition monitoring as used in industry.

UNIT-II (9+3)

Transducers and Instrumentation for Recording and Analysis: Vibration transducers, Displacement transducers, velocity pickups, accelerometers, Temperature transducers, Vibration meters, FFT analyzers, Time domain instruments, Tracking analyzers, Magnetic tape recorders, amplifiers.

UNIT-III (9+3)

Analyzing Machine Condition: General characteristics-Process measurements, vibration. Typical vibration sources, symptoms of other common machinery problems. Development and use of acceptance limits-guide lines and limits based on physical constraints, Vibration severity criteria, changing machinery condition-time trends, statistical limits, detailed diagnostic monitoring.

UNIT-IV (9+3)

Data Processing & Vibration Analysis: Fourier analysis, frequency analysis techniques, vibration signature, vibration monitoring equipment, system monitors and vibration limit detectors. Primary and secondary performance parameters, performance monitoring systems.

Text Books:

1 Collacott, R.A., *Mechanical Fault Diagnosis and Condition Monitoring,* Chapman and Hall, London, 1977.
2 John S.Mitchell: *Introduction to Machinery Analysis and Monitoring,* 2/e, Pennwell Books, Oklahama.

Reference Books:

1. Trever M. Hunt, *Condition Monitoring of mechanical & Hydraulic Plant* A concise introduction and guide, Chapman & Hall, Madras
2. Philip Wild, *Industrial Sensors and applications for Condition Monitoring*, Mechanical Engineering Publications Ltd., London
3. Joseph Mathew, *Common Vibration Monitoring Techniques – handbook of Condition Monitoring*, Chapman & Hall

Course Learning Outcomes:

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

- *Learn preventive maintenance*
- *Analyze Machine Condition*
- *Perform Vibration Analysis*

P14DE205B FATIGUE, FRACTURE AND FAILURE ANALYSIS

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *Provide an understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.*
- *Provide a thorough introduction to the principles of fracture mechanics.*
- *Provide practical examples of the application of fracture mechanics to design and life prediction methods and reporting.*

UNIT-I (9+3)

Introduction to fatigue and fracture mechanics, ductile and brittle fractures. Mechanism of fatigue crack initiation and propagation, fatigue data representation,

UNIT-II (9+3)

Factors influencing fatigue strength, life prediction, prevention of fatigue failures, corrosion fatigue.

UNIT-III (9+3)

Linear elastic fracture mechanics, determination of fracture toughness, elastic plastic fracture mechanics, sub-critical growth in reactive environment.

UNIT-IV (9+3)

Fatigue and fracture safe designs. Investigation and analysis of failures, case studies in fatigue and fracture mechanics.

Text Books:

1. S.T. Rolfe and J.M. Barsom, *Fracture and Fatigue Control in Structure*, Prentice Hall, 1977.

Reference Books:

1. D.Broek, Elementary Engineering Fracture Mechanics, Noordhoff
2. S,Kocanda: Fatigue failure of Metals, Synthofford Noordhoff,
3. N.E. Fros, et al. Metal fatigue, Clarendon Press
4. American Society for Metals, Case histories in failure analysis, ASM

Course Learning Outcomes:
Upon successful completion of the course, student will be able to:

- *Use simple continuum mechanics and elasticity to determine the stresses, strains, and displacements in a loaded structure.*
- *Make Mathematical modeling of the elements of plastic deformation, with respect to continuum and microscopic mechanisms.*
- *Use creep data to predict the life of structures at elevated temperatures and the understanding of mechanisms of creeep deformation and fracture.*
- *Use the fracture mechanics to quantitatively estimate failure criteria for both elastically and plastically deforming structures, in the design of life prediction strategies, and for fracture control plans, with examples from automotive, aerospace, medical, and other industries.*
- *Understand the fatigue and its effects on structural lifetimes of components.*

P14DE205C VIBRATIONS OF CONTINUOUS SYSTEMS& NOISE CONTROL

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *To understand longitudinal, torsional vibration of rods, transverse vibration*
- *To learn about the quantification of human response to sound*
- *To understand issues related to noise induced hearing loss*
- *To understand the different techniques used for preventing excessive transmission of sound*

UNIT-I (9+3)

Continuous Systems: Introduction, Vibration of strings, longitudinal vibrations of bars, torsional vibration of rods, transverse vibration of beams, suspension bridge as continuous system, Euler equation for beams, system with repeated identical sections.

UNIT-II (9+3)

Mode Summation Procedures for Continuous Systems: Mode Summation method, Normal Modes of constrained structures, Mode acceleration method, Component-Mode Synthesis.

UNIT-III (9+3)

Sound Level &Response: Introduction, Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, Decibel Scale, Sound Power, Sound Intensity and Sound Pressure Level, sound spectra, various sound fields, octave band analysis, Loudness, Weighting Networks and Equivalent Sound level .

UNIT-IV (9+3)

Major Sources of Noise, Noise Standards and Limits, Noise Survey Techniques, Measurement Technique for Vehicular Noise, Noise due to Construction Equipments and Domestic Appliances, Industrial Noise sources, Industrial Noise Control-Strategies, Noise Control at the Source, Noise Control along the path, Acoustic Barriers, Noise Control at the receiver.

Text Books:

1. Mechanical Vibrations and Noise Engineering, A.G.Ambekar, Eastern Economy Edition, Prentice -Hall India.

2. Theory of Vibration with applications, William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan; Pearson Education.

Reference Books:

1. Peter Hagedorn and Anirvan DasGupta: Vibrations and Waves in Continuous Mechanical Systems, Wiley, 2007
2. Leonard Meirovitch: Analytical Methods in Vibrations, The Macmillan Co.,
3. S.S. Rao: Vibration of Continuous Systems, Wiley, 2007

Course Learning Outcomes:

Upon successful completion of the course, student will be able to:

- *Understand the behavior of Continuous systems*
- *Understand issues related to noise induced hearing loss*
- *Understand the regulatory aspects of noise control, Measurement of environmental noise*

P14DE205D DESIGN OF PRESSURE VESSELS AND PIPING

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *get exposure to pressure vessels & related equipment*
- *Acquaint with their actual designs, involving layout, thermal and mechanical design, with real examples from the industry.*

UNIT-I (9+3)

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

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

UNIT-II (9+3)

Design of Vessels: Localized stresses and their significance – 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-III (9+3)

Supports for Vessels: introduction, bracket or lug supports, leg supports, skirt supports, saddle supports.

Buckling and Fracture Analysis in Vessels: Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure.

UNIT-IV (9+3)

Buckling: Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

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

Text Books:

1. John F.Harvey, *Theory and Design of Pressure Vessels,* CBS Publishers and Distributors, 1987.
2. M.V. Joshi, *Process Equipment Design,* Macmillan India Ltd.

Reference Books:

1. Henry H.Bedner, *Pressure Vessels*, Design Hand Book, CBS Publishers and Distributors,
2. Stanley, M.Wales, *Chemical process equipment, selection and Design*, Butterworths series in Chemical Engineering,
3. 3. William J., Bees, *Approximate Methods in the Design and Analysis of Pressure vessels and Piping*, Pre ASME Pressure Vessels and Piping Conference.

Course Learning Outcomes:

The student, at the end of the course, should be able –

- *To conceive a design based on the information provided for a particular application*
- *To learn the sizing of the equipment*
- *To predict the thermal behavior and carry out a stress analysis*
- *To come up with a mechanical design as per the relevant codes*
- *To do the cost economic analysis*

P14DE206A ADVANCED MATERIAL SCIENCE

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *Have Knowledge of sound fundamentals of dynamic multilevel microstructure*
- *apply mathematics and science to engineering problems*
- *perform mechanistic modeling*
- *acquire Knowledge of computational materials science*
- *acquire Knowledge of basic and advanced instrumentation for the characterization of structure and properties*
- *acquire Knowledge of basic and advanced processing practice*
- *identify and formulate complex problems*
- *have understanding of how user needs define materials performance requirements*
- *have an understanding of the global/societal context of engineering problems*

UNIT-I (9+3)

Introduction to Engineering Materials: Types of materials, material engineering Structures of solids, crystalline materials, formation crystal structures, Determination of structure, Defects in materials, their classification and significance. Effects of defects on properties.

Non-crystalline Solids: Types and their structures, Importance of non-crystalline structure, Role of bonding on structures, Multi component phases and their structures. Effect of various factors on phase formation, phase diagrams and their significance. Non-equilibrium structures.

UNIT-II (9+3)

Structural Modifications: Atomic movement in solid state, Transformation kinetics, tailoring of macrostructures, typical heterogeneous transformations.

Mechanical behavior of Materials: Introduction, deformation processes. Fatigue, creep and Fracture and their behavior. Determination of properties of materials.

UNIT-III (9+3)

Composite Materials: Introduction, Principle, classification, Materials for reinforcement and matrix, their characteristics, processing techniques for composites, Micro-mechanics of composites, Mechanical properties of composites, Applications of composites.

UNIT-IV (9+3)

Surface Engineering: Surface cleaning and finishing, surface plantings, Conversion coating, shard facing, thermal spraying, diffusion processes, Special surface treatments, organic coatings, process selection

Materials Selection: Design process, selection factors, Materials for typical machine components, Selection case histories.

Text Books:

1 V.S.R. Murthy, AK. Jena, K.P. Gupta and G.S.Murthy, *Structure and properties of Engineering Materials,* Tata McGraw-Hill Publishing Company, 2003.

1 Kenneth G. Budinski, Michael K. Budinski, *Engineering Materials properties and Selection, 7/e,* Prentice Hall of India, 2003.

Reference Books:

1. William D. Callister, Jr, *Materials, Science and Engineering: An Introduction, 6/e,* John Wiley & Sons, 2004.
2. Donald R. Askeland *A Science of Engineering Materials,* University of Missouri, Rolla.

Course Learning Outcomes:

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

- *Get the knowledge of the dynamic nature of all structure, including materials and the systems and environments they serve*
- *perform theoretical, conceptual and computational design approaches*
- *perform experimental optimization employing statistical design of experiments techniques*
- *apply the theoretical and experimental design techniques to both materials and processes*

P14DE206B MEMS AND NANOTECHNOLOGY

Class: M. Tech. II Semester Branch: Design Engg.

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:

- *understand how basic Nano systems work;*
- *use physical reasoning to develop simple nanoscale models to interpret the behavior of such physical systems;*
- *understand the major issues in producing a sustainable nanotech industry.*

UNIT-I (9+3)

Overview of MEMS and Microsystems: Typical MEMS and Micro-system products. Evolution of Micro-fabrication, Microsystems and Miniaturization. Applications of Microsystems in Industrial products, applications in Telecommunications.

Working Principles of Microsystems: Micro-sensors, Micro-actuation, MEMS with Micro-actuators, Micro accelerators, Micro-fluidics.

UNIT-II (9+3)

Engineering Science for Microsystems Design: Ions and Ionization, Doping of Semiconductors, the Diffusion process, Plasma physics, Electrochemistry, Quantum Physics. Micro-system Fabrication Processes: Photolithography, Ion implantation, Diffusion, Oxidation, Chemical vapor deposition, Physical vapor Deposition-Sputtering, Deposition by Epitaxy, Etching. Overview of Micro-manufacturing-Bulk micro-manufacturing, Surface micromachining, the LIGA process.

UNIT-III (9+3)

Materials for MEMS and Microsystems: Substrates and Wafers, Active Substrate Materials, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers, Packaging Materials.

Scaling Laws in Miniaturization: Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer.

UNIT-IV (9+3)

Microsystems Design and Packaging: Design considerations, Process Design, Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a micro-pressure sensor, Design of Micro-fludic Network systems. Essential packaging Technologies. Selection of packaging Materials, Signal Mapping and Transduction.

Nanotechnology, Nanomachines, Nanorobots, Nanotubes, Nanowires, Nanomechanical amplifiers, Nanotransisters, tera-storage devices, Molecular engineering, DNA computing, Nanomedicine, Smart pills, Nanofabrication of structures.

Text Books:

1 T-R. Hsu, *MEMS & Microsystems: Design and Manufacture,* Tata McGraw-Hill, New Delhi, 2002.

Reference Books:

1. M.E.lwenspoek and R. Wiegerink, *Mechanical Microsensors*, Springer-Verlag, 2001
2. G.T.A. Kovacs, *Micromachined Transducers Source Book,* McGraw-Hill, 1998.
3. S.D. Senturia, *Microsystem Design*, Kluwer, 2001.
4. *http;//www.wpi.edu/˜chslt*
5. K. Eric Drexler, *Nanosystems: Molecular Machinery, Manufacturing, and Computation*, John Wiley, New York, 2002.
6. Charles P. Poole, Jr., Frank J. Owens, *Introduction to Nanotechnology* , John Wiley, 2002.

Course Learning Outcomes:

Upon successful completion of the course, student will demonstrate:

- *Use knowledge of nano science and mathematics to: Follow protocols, Conduct science or engineering procedures, Fabricate products, Make conclusions about results, Troubleshoot, Discover*
- *Function effectively in a laboratory environment using complex instrumentation machinery and protocols*
- *Independently seek out innovations in the rapidly changing field of nano-technology*
- *Compile and analyze data and draw conclusions at the nano level.*
- *Design, implement and document experiments*
- *Collaborate and communicate effectively in a high tech environment*

P14DE206C SMART STRUCTURES

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

Course Learning Objectives:
To provide students with knowledge of the mechanical behaviour, manufacturing process and utilizations of advanced smart materials and structures for product design and development with a special emphasize on aircraft applications.

UNIT-I (9+3)

Smart structures and Materials: Definitions, instrumented materials-basic considerations, functions and responses, structural responses, sensing systems, self-adiagnosis, signal processing considerations, Actuating systems and effectors, applications.

UNIT-II (9+3)

Sensing Technologies: Specifications and terminology for sensors in smart structures, physical measurements-piezoelectric strain measurement, inductively read transducers-the LVDT, fiber optic sensing techniques.

UNIT-III (9+3)

Actuator techniques; Mechanical impedence, conversion efficiencies and matching.Actuators and actuator materials, piezo electric and electro restrictive materials, magnetorestrictive materials, shape memory alloys, electrorheological fluids, electromagnetic actuation.

UNIT-IV (9+3)

Signal processing and control of smart structures: Sensors as geometrical processors, signal processing, control systems, the linear and the non-linear.Smart structures-Some applications: Smart composites, Mechanical analysis and self testing structures.

Text Books:

1. **Culshaw B.,** ***Smat Structures and Materials*****, Artec House, Boston, 1996.**

Reference Books:

1. Gandhi M.V., and Thompson, *Smart Structures and Materials,* Chapman & Hall, New York, 1992.
2. Banks, H.T., Smith, R.C. and Wang, Y., ***Smart Material Structures: Modeling, Estimation and Control*****, John Wiley & Sons, New York, 1996.**
3. Srinivasan, A.V. and Michael Me Farland, D., *Smart Structures: Analysis and Design,* Cambridge University Press, Cambridge, 2001.

Course Learning Outcomes:

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

- *understand the working principle of advanced smart structures including failure mechanisms;*
- *possess the state-of-the-art knowledge on smart materials and smart structure design;*
- *recognize the importance of smart materials in advanced technology;*
- *Understand the application of smart materials, smart structures in aircraft design.*

P14DE206D INDUSTRIAL TRIBOLOGY

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

***Course Learning Objectives*:**

- *Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.*
- *Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.*
- *Interpret the latest research on new topics in tribology including its application to nanoscale devices and biological systems.*
- *To deal with design of fluid containment systems like seals and gasket,*
- *Modeling systems as hydrostatic, squeeze film and elasto-hydrodynamic lubrication will be studied as infinite and later finite structures.*
- *Gas (air) lubricated and rolling contact type motions with deformation at contact will be studied as special systems*

UNIT-I (9+3)

INTRODUCTION: Defining Tribology, Tribology in Design - Mechanical design of oil seals and gasket, Tribological design of oil seals and gasket, Tribology in Industry (Maintenance), Defining Lubrication, Basic Modes of Lubrication, Properties of Lubricants, Lubricant Additives, Defining Bearing Terminology - Sliding contact bearings ,Rolling contact bearings Comparison between Sliding and Rolling Contact Bearings

FRICTION and WEAR: Friction - Laws of friction - Friction classification - Causes of Friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids – Wear between solid and liquid - Factors affecting wear – Measurement of wear, Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication, Bearing Materials and Bearing Construction

UNIT-II (9+3)

LUBRICATION of BEARINGS: Mechanics of Fluid Flow - Theory of hydrodynamic lubrication -Mechanism of pressure development in oil film. Two Dimensional Reynolds's Equation and its Limitations, Idealized Bearings, Infinitely Long Plane Fixed Sliders, Infinitely Long Plane Pivoted Sliders, Infinitely Long Journal Bearings, Infinitely Short Journal Bearings, Designing Journal Bearing - Sommerfeld number - Raimondiand Boyd method - Petroff's Solution - Parameters of bearing design - Unit pressure Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness

HYDRODYNAMIC THRUST BEARING: Introduction , Pressure Equation , Load , Center of Pressure , Friction - Flat plate thrust bearing - Tilting pad thrust bearing

UNIT-III (9+3)

HYDROSTATIC and SQUEEZE FILM LUBRICATION: Hydrostatic Lubrication - Basic concept - Advantages and limitations - Viscous flow through rectangular slot – Load carrying capacity and flow requirement - Energy losses -Optimum design. Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads, Application to journal bearings, Piston Pin Lubrications

ELASTO-HYDRODYNAMIC LUBRICATION: Principles and Applications, Pressure viscosity term in Reynolds's equation, Hertz's Theory,Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings,Rolling element bearings

UNIT-IV (9+3)

GAS (AIR-) LUBRICATED BEARINGS: Introduction, Merits, Demerits and Applications, Tilting pad bearings, Magnetic recording discs with flying head, Hydrostatic bearings with air lubrication, Hydrodynamic bearings with air lubrication, Thrust bearings with air lubrication

TRIBOLOGICAL ASPECTS of ROLLING MOTION: The mechanics of tyre-road interactions, Road grip and rolling resistance, Tribological aspects of wheel on rail contact

FINITE BEARINGS: Hydrostatic bearings, Hydrodynamic bearings, Thrust oil bearings, Porous Bearings, Foil bearings, Heat in bearings

Reference Books:

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry, Sushil Kumar Srivatsava, - S. Chand &Co.
3. Tribology, B.C. Majumdar, - Tata McGraw Hill Co Ltd.
4. Introduction to Tribology Halling, - Wykeham Publications Ltd.
5. Tribology H.G.Phakatkar and R.R.Ghorpade - Nirali Publications

Course Learning Outcomes:

Upon completion of the subject, students will:

- *Mastery of a broad and working knowledge of the principles of Tribology*
- *An Ability to design and analyze advanced systems, components, and processes*
- *in their professional practice*
- *Present the fundamental theories of tribology and classical solutions to interface behavior*

P14DE207 FEM LAB

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	**40 marks**
End Semester Exam :	**60 marks**

List of Exercises

Part A:

Students will be allotted individual course projects that involve development of code using MATLAB. At the end of the Semester, each student will be required to present the results of the problem obtained from the code.

Part B:

1. Statically indeterminate reaction force analysis
2. Beam stresses and deflections
3. Thermally loaded support structure
4. Deflection of a hinged support
5. Residual stress problem
6. Combined bending and torsion
7. Bending of a solid beam (Plane elements)
8. Tie rod with lateral loading
9. Thermal structural contact of two bodies
10. Stresses in a long cylinder

Exercises from Part B will be solved using ANSYS package during regular class work in each week.

Reference Books:

1. **Chandrupatla, T.R. and Belegundu, A.D.,** Introduction *to finite Elements in Engineering, 2/e,* Pearson Education, New Delhi, 2003.
2. ANSYS 5.6, Verification Manual.
3. ANSYS Structural Analysis Guide.

P14DE208 AUTOMATION & ROBOTICS LAB

Class: M. Tech. II Semester **Branch: Design Engg.**

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

LIST OF EXPERIMENTS

1. Controlling of AC Non Servo motors using LS controller
2. Controlling of DC Servo motors using LS controller
3. Integration of PLC and PMC.
4. Simulation of Robot Motion using Robo X software
5. Study of Automated machines.
6. Simulation of Manufacturing and Material handling systems.

P14DE209 COMPREHENSIVE VIVA -VOCE

Class: M. Tech. II Semester Branch: Design Engg.

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	**-**
End Semester Exam :	**100 marks**

There shall be only external oral examination for Comprehensive Viva-voce on a pre-notified date. The oral examination shall cover the entire content of courses covered in First and Second Semesters.

P134DE301 INDUSTRIAL TRAINING

Class: M. Tech. III Semester **Branch: Design Engg.**

Duration: 8weeks

Teaching Scheme:

L	T	P	C
-	-	3	4

Examination Scheme:

Continuous Internal Evaluation:	**100 marks**
End Semester Exam :	**60 marks**

- M. Tech. Coordinator in consultation with the Training & Placement Section has to procure training slots, for the students before the last day of instruction of 2nd semester.
- The students shall confirm their training slots by the last day of 2nd semester
- The students after 8 weeks Industrial Training shall submit a certificate, a report in the prescribed format before the last date specified by the Department Post Graduate Review Committee (DPGRC).The DPGRC shall evaluate their submitted reports and oral presentations.

P14DE302 DISSERTATION

Class: M. Tech. III Semester **Branch**: **Design Engg.**

Duration: 16Weeks

Teaching Scheme:

L	T	P	C
-	-	3	8

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Exam :	-

Continuous Internal Evaluation (CIE) for Dissertation:

- **Dissertation** shall be normally conducted in two stages, spread over two sequential semesters i.e. third and fourth semester.
- **Registration Seminar** shall be arranged within four weeks after completion of the Industrial Training and Seminar in the 3rd semester. The Registration Seminar shall include a brief report and presentation focusing the identified topic, literature review, time schedule indicating the main tasks, and expected outcome.
- **Progress Seminar-I:** At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before the DPGRC. The Continuous Internal Evaluation (CIE) for the third semester is as follows:
-

Assessment	Weightage
Dissertation Supervisor Assessment	50%
DPGRC Assessment	50%
Total Weightage:	**100%**

P14DE401 DISSERTATION & VIVA-VOCE

Class: M. Tech. IV Semester **Branch: Design Engg.**

Duration: 24 weeks

Teaching Scheme:

L	T	P	C
-	-	3	12

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

- **Progress Seminar-II** shall be arranged during the 6th week of IV semester.
- **Progress Seminar-III** shall be arranged during the 15th week of IV semester.
- **Synopsis Seminar** shall be arranged two weeks before the final thesis submission date. The student shall submit a synopsis report covering all the details of the works carried out duly signed by the Dissertation Supervisor.
- At the end of second stage (fourth semester), student shall be required to submit two bound copies, one being for the department and other for the Dissertation Supervisor. The Dissertation report shall be evaluated by the DPGRC and external examination shall be conducted on a pre-notified date. The Dissertation evaluation for the fourth semester is as follows:

Assessment	Weightage
Dissertation Supervisor Assessment	20%
DPGRC Assessment	20%
ESE (Presentation & Viva-voce)	60%
Total Weightage:	**100%**