M.E Mechanical Engineering (Design & Thermal) (Part Time)
Proposed Scheme for CBCS

SEM I				
S.NO	***Sub Code***	***Sub Name***	***Number of Credit***	***SubType***
1.	DTP1C1	Tribology	3-1-1 =5	PC1
2.	DTP1C2	Design of Internal Combustion Engine Systems	3-1-1 =5	PC2
3.		***Generic Elective I***	3-1-0 =4	GE1
4.	DTP1V1	Comprehensive Viva I	0-0-2=2	
Total Credit for SEM I			**14 actual + 2 Virtual credits**	

Devi Ahilya University, Indore, India Institute of Engineering & Technology				**M.E.(Design & Thermal) Semester A Part Time**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTP1C1 **Tribology**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

COURSE CONTENTS

Objectives & Pre requisites:

The basic objective of the subject is to deal fundamentals of friction, wear and lubrication. The subject is useful in understanding the nature of surfaces of engineering materials. The Pre requisites are material science and machine design.

UNIT- 1

Fundamentals of Tribology:

Introduction to tribology and its historical background, Industrial importance, factors influencing Tribological phenomenon. Engineering surfaces- surface characterization, computation of surface parameters. Surface measurement techniques.

UNIT- 2

Friction:

Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction, friction of elastomers, friction of various materials, friction measurement methods.

UNIT- 3

Wear:

Introduction, types of wear, wear mechanism, minor forms of wear, wear debris analysis, wear testing method, wear of metals, ceramics, polymers, system approach for wear reduction.

UNIT-4

Lubrication:

Basic principal of lubrication, choice of lubricant type, selection of lubrication oils, oil changing and oil conservation, oil feed system, Greece and anti seizes, gas bearing, lubricating sealing, lubricating testing and specifications, lubrication monitoring.

UNIT- 5

Design for Tribological Elements:

An overview of engineering materials having potential for tribological application, characterization and evaluation of ferrous materials for tribological requirements/application, selection of ferrous materials for

rolling element bearings, Boundary lubrication, Hydrodynamic lubrication, elastohydrodynamic lubrication, Design of hydrodynamically loaded journal bearing, externally pressurized bearing, rolling element bearing, performance analysis of bearing.

BOOKS RECOMMENDED

[1] Moore F Desmond ***,Principals and application of Tribology***, ,Pergamon press,1975

[2] Sahoo Prashant ***Engineering Tribology***, Prentice-Hall of India, New Delhi, 2005
[3] Lansdown A R ,***Lubrication, A practical Guide to Lubricant selection***, Pergamon Press1982
[4]Majumdar BC***, Introduction to Tribology of Bearings***, Wheeler Publishing, New Delhi,1999

LABORATORY EXPERIMENTS:

1. Performance analysis of Journal Bearings.
2. Experimental analysis of Lubricants.
3. Experimental analysis of Friction on different material.
4. Study of method for Wear Debris analysis.
5. Design analysis for Hydrodynamic Journal Bearing and rolling contact bearing

Subject Code & Name	Instructions Hours per Week			Credits			
DTR1C2 **Design of Internal Combustion Engine Systems**	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Objectives: To impart the knowledge of Internal combustion engine from systems design perspective.

Pre requisites: Fundamentals of thermodynamics, Combustion process, Theory of Internal combustion Engines.

COURSE CONTENT

UNIT-1

Genesis

Evolution: Limitation of Steam Engines, Hot Air Engine, Internal Combustion Engines, Atmospheric Engines, Lenoir Engines, Otto-Langen Engine; Engine Cycles; Flow chart of typical Internal Combustion engine processes; Classification; Configurations; Operational and performance parameters; Fuels for engines: composition, characteristics.

UNIT-2

Induction and Exhaustion Systems

Gas exchange; Intake system: Air-filter, Carburetor, Injectors: throttle body, port, direct injection; Diesel Injection: Low and High pressure Common Rail Systems, Jerk pump systems, Electronically controlled; Manifolds; Superchargers and turbochargers; Exhaust Systems; Exhaust manifold, Exhaust Pipe, Catalytic Converter, Muffler; Valves Flows:Flow Patterns, Discharge Coefficient, Performance, Timing and its Effects; Scavenging: Performance parameters; Volumetric Efficiency.

UNIT-3

In-cylinder flows and Combustion Thermochemistry

In-cylinder flows: Measurement; Swirl: Induction Swirl, Swirl Coefficient, Swirl Ratio; Swish; Tumble; Squish; Prechamberflows;Stoichiometry Relations: Air required for Complete Combustion based on Fuels, Incomplete Combustion, Calculation of Dry Flue Gases for known fuel composition, Estimating Fuel Composition and Excess Air quantity from Exhaust Gas Analysis, Flue Gas Analysis (O_2, CO_2, CO, NO_x, SOx); Combustion Terminology: Adiabatic Flame temperature, Combustion Rates, Equilibrium Coefficient, First Law applied to Chemical Reactions Combustion Efficiency.

UNIT-4

IC Engines Sub Systems

Starting and Charging systems; Ignition Systems; Engine Heat transfer and Cooling systems; Engine friction and lubrication systems; Mechanisms for system operations.

UNIT-5

Pollutant Formation and Control

Emission Formation in SI Engines: Constituents, Formation Mechanisms: Hydrocarbon, Carbon Monoxide, Oxides of Nitrogen, Carbon dioxide, Aldehydes; Control Techniques; Fuel Injection Technologies, Heated Oxygen Sensors, Emission formation in CI Engines: Constituents, formation Mechanisms: Carbon Monoxide, Unburned Hydrocarbons, Oxides of Nitrogen, Compounds of Sulpher, Particulate Matter, Control Techniques: Fuel Injection Technology, Electronically Controlled Distribution, Electronic Unit injector System, After Treatment Devices.

Text Books:

[1] Engineering Fundamentals of internal Combustion Engines, Willard W. Pulkrabek, Printice Hall New Jersey.
[2] Internal Combustion Engine Fundamentals, John B Heywood, McGraw-Hill Book Company, New York, 1988.

Reference Books

[3] Internal Combustion Engines Applied Thermosciences, Colin R. Ferguson and Allan T. Kirkpatrick, John Wiley & Sons, 2e, 2004
[4] Internal Combustion Engines, V. Ganesan, Tata McGrraw-Hill, New-Delhi, 1990
[5] An Introduction to Combustion: Concept and Applications, Stephen R. Turns, McGraw-Hill Education (India), New-Delhi, 2011

List of Experiments

1. Study of various IC engine Components and Sub-systems.
2. Study of Induction and Exhaustion Systems
3. Study of Ignition Systems, Cooling systems, lubrication systems for IC engine systems
4. Simulation and Modeling of Spark Ignition engines
4.Simulation and Modeling of Compression Ignition engines
5. Emission measurement in Spark Ignition and Compression Ignition Engines.

SEM II				
1.	DTP2C3	Advanced Machine Design	3-1-1 =5	PC3

2.		***Elective I***	3-1-1 =5	PE1
3.	DTP2W1	Seminar/ Res. Tool/Work Shop-1	0-2-0=2	
4	DTP2V2	Comprehensive Viva II	0-0-2=2	
5.	ASP2S1	Soft Skills -1	2-0-0 =2	
Total Credit for SEM II			**14 actual + 2 Virtual credits**	
List of Generic Elective I				
1.	**DTP1G1**	**Advanced Thermodynamics**		
2.	DTP1G2	Non Conventional Energy Systems		
3.	DTP1G3	Management Information System		
4.	DTP1G4	Finite Element Analysis		
List of Elective I				
1.	**DTP2E1**	**Advanced Mechanics of Solids**		
2.	DTP2E2	Fatigue Creep and Fracture		
3.	DTP2E3	Mechanism and Robot Kinematics		

Course Objectives: The objective of the subject is to deal with failure analysis and advanced areas of design of machine elements based on reliability, fatigue, creep. Also deals with the fracture

Devi Ahilya University, Indore, India Institute of Engineering & Technology				**M.E.(Design & Thermal) Part Time**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTP2C3 **Advanced Machine Design**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

mechanics approach to design.

Prerequisite(s): Pre requisites are Material science, Machine Design I and Machine Design II.

COURSE OF CONTENTS

Unit-I

Introduction to Advanced Mechanical Engineering Design:

Review of materials and processes for machine elements. Case studies of mechanical engineering design failures. Review of static strength failure analysis – theories of failure.

Unit-II

Reliability and Optimum based Design :

Introduction to optimum design, analysis of simple machine members based on optimum design. Fundamentals of reliability ,System concepts in Reliability engineering. Failure distributions, Statistical analysis of failure data, Weibull analysis, dimensioning.

Unit-III

Design for Dynamic Loading:

High cycle and low cycle fatigue, Fatigue strength. Design of Mechanical Equipment Elements. Exercises of fatigue design of shafting and gears. Exercises of surface fatigue design of rolling contact bearings including linear bearings.

Unit-IV

Design for Creep:

Introduction to Design for creep. Combined creep and fatigue failure prevention. Design for low temperature (Brittle failure). Design for corrosion, wear, hydrogen embrittlement, fretting fatigue and other combined modes of mechanical failure.

Unit-V

Fracture mechanics:

Introduction: Fracture mechanics approach to design, the energy criterion, the stress intensity approach, effect of material properties on fracture, dimensional analysis in fracture mechanics.

Fundamental concepts: Stress concentration effect of flaws, the Grifith energy balance, the energy release rate, instability and the R curve, stress analysis of cracks, K as a failure criterion. Fracture toughness testing of metals

Note: Only Mechanical Engineer's Handbook, Data-books and certified notes are allowed in the examination hall.

Text Books:

[1] Shingley J.E., ***Mechanical Engineering Design***, McGraw-Hill 2003

[2] Dieter G.E., ***Engineering Design***, McGraw-Hill 2000.

[3] Mubeen., Machin*e Design*, , Khanna Publications(P) Ltd.,2004

Reference Books:

[1] Spotts M.F.,Shoup T.E., Hrnberger L.E., ***Design of Machine Elements***, Pearson Education ,8e,2006

[2] ShariffA.,*Design of Machine Elements*,Dhanpat Rai Publications(P) Ltd.,3e,1995

Devi Ahilya University, Indore, India Institute of Engineering & Technology				1 Year M.E.(Design & Thermal Engg.) Part Time			
Subject Code & Name	Instructions Hours per Week			Credits			
DTP1G2 DTP1G1	L L	T T	P P	L L	T T	P P	Total Total
Advanced Thermodynamics	**3**	**1**	**-**	**3**	**1**	**-**	**4**
Duration of Theory Paper: 3 Hours							

Objective: The basic objective of the subject is to deal fundamentals of Thermodynamics, Compressible Fluid Flowproperties, Thermodynamics relations & Exergy.

Prerequisite: Basic Engineering Thermodynamics.

COURSE CONTENT

UNIT 1
Mass And Energy Analysis Of Control Volume
Control Volume, Steady Flow Process, Mass Balance and Energy Balance in a Simple Steady Flow Processes, Variable Flow Processes, Comparison of SFEE with Euler and Bernoulli Equations, Examples of a Variable Flow Problems. Illustrative Problems.

UNIT 2
Thermodynamic Property Relations
Mathematic Theorems, Maxwell,s Relations, TdS Equations, Heat Capacities, Joule Kelvin Effects, ClaussiusClapeyron Equation, Gibb's Phase Rule, General Thermodynamic considerations on an Equation of State.Illustrative Problems

UNIT 3
Exergy
Work Potential of Energy, Reversible work and Irreversibility, Second Law Efficiency, Exergy Change of System, Exergy of a Closed System, Exergy of a Steady Flow System, Maximum Work Obtainable Conditions,Illustrative Problems

UNIT 4
Vapour Power Cycles
General Aspects, Simple Steam Power Cycle, Rankine Cycle, Reheat Cycle, Ideal Regenerative Cycle, Feedwater Heaters, Exergy Analysis of Vapour Power Cycles,Illustrative Problems

UNIT 5
Finite Time Thermodynamics
General Aspects, Application of principles on Reversible and Irreversible Cycles, Maximum Power Output conditions, Effect of Cycle Irreversibility Parameter on the performance of the Cycles, Performance of Engines working under Maximum Power and Maximum Power Density conditions, Entropy Generation Minimization, Concepts of Virtual Entropy,Illustrative Problems.

Books Recommended:
[1.] Y.A Cengel, *Thermodynamics-An Engineering Approach* , McGraw Hill Companies,2006.
[2.] P.K Nag, *Engineering Thermodynamics*,The McGraw Hill Companies, Third Edition
[3.] G.E Myers, *Engineering Thermodynamics* ,Prentice Hall, Third Edition

Non Conventional Energy Systems	3	1	0	3	1	0	4
Duration of Theory Paper: 3 Hours	Dev Ahilya University, Indore, India Institute of Engineering & Technology			I Year ME (Design & Thermal Engg.) Part Time			

Objective: The objective of the subject to acquaint the students the renewable energy technological systems, its principle ,working, system design and analysis of present systems, to analysis the environmental and cost economics of using renewable energy sources compared to fossil fuels.

Pre requisites: Thermal Engineering, Heat and Mass transfer, fluid mechanics, steam engineering, combustion technology.

COURSE CONTENT

UNIT-1

Solar Energy

Solar radiation its measurements and prediction - solar thermal flat plate collectors concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping,power generation schemes. Design and Thermal analysis.

UNIT-2

Wind Energy

Atmospheric circulations – classification - factors influencing wind - wind shear – turbulence - wind speed monitoring - Betz limit - Aerodynamics of wind turbine rotor- site selection - wind resource assessment - wind energy conversion devices - classification, characteristics, and applications. Hybrid systems - safety and environmental aspects.

UNIT-3

Bio-Energy

Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of biogas Plants-applications Design of bio gas digesters, landfill gas systems and gasifiers.

UNIT-4

Hydrogen and Fuel Cells

Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Bio photolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – performance characteristics ,principle of working- various types - construction and applications.

UNIT-5

Other Types of Energy

Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection, and geothermal power plants, MHD, Thermal analysis

Note: HMT Data-books and certified notes are allowed in the examination hall.

BOOKS RECOMMENDED:

[1] Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.
[2] Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
[3] Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				I Year ME (Design & Thermal Engg.) Part Time				
Subject Code & Name	Instructions Hours per Week			Credits				
DTP1G3 DTP1G4 **Management Information System**	L 3	T 1	P 0		L 3	T 1	P 0	Total 4
Duration of Theory Paper: **3 Hours**								

Objectives & Pre requisites:

The basic objective of the subject is to deal fundamentals of Management Information System. The subject is useful in understanding the various information sources and database structures.

COURSE OF CONTENT

Unit-1

Introduction to Management Information Systems

An Overview of Management Information Systems, Structure of a Management information System

Survey of Information Systems Technology

Hardware, Software, and Communication technology for Information Systems, Storage and Retrieval of Data, Transaction Processing, Office Automation and Information processing Control Functions.

Unit-2

Conceptual Foundations

The Decision Making Process, Concepts of Information, Humans as information Processors, System Concepts, Concepts of Planing and Control, Organizational Structures and Management Concepts.

Unit-3

Information Based Support System

Support Systems for Planing, Control and Decision Making, Support Systems for Management of Knowledge Work.

Unit-4

Information System Requirements

Developing a Long Range Information System Plan, Strategies for the Determination of Information Requirements, Database Requirements, User Interface Requirements.

Unit-5

Development, Implementation and Management of Information System Resources

Developing and Implementing Application Systems, Quality Assurance and Evaluation of Information Systems, Organizational and Management of the Information Resources Functions, Future Development and Their Organizational and Social Implications.

Text Books

[1] Gordan B. Davis and Margrethe H. Olson, "Management Information Systems - Conceptual Foundations, Structures and Development, Mcgeaw Hills International Editions.

Reference Books

[1] Laudon, Kenneth C., and Laudon, Jane P., Management Information Systems-Managing Digital Firm, Tenth Edition, Prentice Hall, 2007
[2] Management Information Systems, Loudon and Loudon, 10th edition, Pearsons Educations
[3] Management Information System, Oz Thomson Learning 5th edition
[4] Management Information System, W.S.Jawadekar, 3rd edition, TMH
[5] Management Information System, James O'Brien, 7th edition, TMH

Finite Element Analysis	3	1	0		3	1	0	4
Duration of Theory Paper: **3 Hours**								

Objectives & Pre requisites:

The basic objective of the subject is to deal with the fundamentals of Finite Element Methods. The subject is useful in understanding the concept of Solving problems using finite element approach.

COURSE OF CONTENT

Unit-1

Introduction

Introduction, Approximate Methods of Analysis, Finite Element Method-An Introduction, Different Approaches in FEM.

Unit-2

Finite Elements and Interpolation Functions

Interpolation Functions, One Dimensional Elements, Two Dimensional Elements, Three Dimensional Elements.

Unit-3

One Dimensional Finite Element Analysis

Linear Spring, Truss Element, 1D Torsion of a Circular Shaft, 1D Steady State Heat Conduction, 1D Flow Through Porous Media, 1D Ideal Fluid Flow Through Pipes, Beam Element, Analysis of Plane Frames and Grids.

Unit-4

Two Dimensional Finite Element Analysis

2D Flow through Porous Media, 2D Stress Analysis, Iso-Parametric Formulation, Finite Element Solution of Partial Differential Equations by Method of Weighted Residual, FEM Formulation Based on Variational Principle, Finite Element Solution of Stokes Flow Equations.

Unit-5

Three Dimensional Finite Element Analysis

Axi-Symmetric Solids, 8 Node Isoparametric Element for 3D Stress Analysis, Computer Implementation of FEM, Applications of Finite Element Method.

Text Books

[1] Y. M. Desai, T. L. Eldho, A. H. Shah, "Finite Element Method with Applications in Engineering", Pearson Publication.
[2] Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", Wiley India (P) Ltd.
[3] Chennakesava R. Alavala, "Finite Element Methods Basic Concepts and Applications", PHI Learning Private Limited.

Reference Books

[1] Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning India.
[2] V. Ramamurti, "Finite Element Method in Machine Design", Narosa Publishing House.
[3] Klaus Jurgen Bathe, "Finite Element Procedures", PHI Learning India.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				I Year ME (Design & Thermal Engg.) Full Time				
Subject Code & Name	Instructions Hours per Week				Credits			
DTR1E1 **Advanced Mechanics of Solids**	L	T	P		L	T	P	Total
	3	1	2		3	1	1	5
Duration of Theory Paper: **3 Hours**								

Course Objectives:

• To develop the analytical methods for solving problems in mechanics of solid those are generally considered beyond the scope of basic course in the discipline. As such, the developments tend to evolve from fundamentals principles such as equilibrium and conservation of energy.
• To understand fundamentals of linear elasticity and energy methods for solving torsion, bending problems.
• To gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures using Finite Element Analysis
Prerequisites: Mechanics of Solids

COURSE OF CONTENTS

Unit-1
3D Analysis of Stresses and strains
Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, strains. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions, Relations between Elastic Constants.

Unit-2
Unsymmetrical Bending
Stresses and deflections in beams subjected to unsymmetrical loading-Kern of section, Deflection of Beams, Shear Center.

Unit-3
Bending of Curved Beams
Bending Stresses and Deflections of Curved Beams.

Unit-4
Introduction to the Finite Element Method
Introduction, Node and Element Notations, The Truss Element, Beam and Frame Elements, Two Dimensional Elastic Elements, Higher Order and Three Dimensional Elastic Elements.

Unit-5
Finite Element Modeling Techniques
Planing and Creating the Finite Element Model (Preprocessing), Element Selection and Mesh Strategy, Load Application, Constraints, Preprocessing Checks, Processing the Model and Postprocessing.

Text Books

[1] Richard G. Budynas, Advanced Strength and Applied Stress Analysis, Mc Graw Hill Education (India), Second Edition, 2014
[2] L. S. Shreenath, Advanced Mechanics of Solids, Tata McGraw Hill Publication, 2014

Reference Books

[1] G H Ryder, Strength of Materials, McMillan India Ltd., Third Edition, 1969.
[2] Timoshenko, *Elements of Strength of Materials,* 5/e,Wadsworth Publishing;1968
[3] Kamal Kumar and R. C. Ghai, Advanced Mechanics of Materials, Khanna Publishers, 2010.

Institute of Engineering & Technology				Full Time			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTR1E2 Fatigue Creep and Fracture	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: *3 Hours*							

Objective of the subject

The objectives of this course will be achieved by learning the phenomenon of fatigue creep & fracture Mechanism inside the metallic bodies also the behavior of the material can be understand under these states.

Prerequisites

Strength of Material, Machine Design& Material Science.

COURSE CONTENTS

UNIT-1

Introduction

Introduction & types of fatigue creep & Fracture phenomenon. Stress Analysis under fatigue, creep & Fracture. Material selection under the given conditions.

UNIT -2

Fatigue

Types of fatigue leading and failure, Fatigue test, endurance limit, S-N diagram; Various failure relations, Viz., Soderberg, Modified Goodman-, Gerber parabolic-, Elliptical-relations; Factors influencing fatigue strength; Influence of stress concentration on fatigue test; Fretting corrosion; Effect of environment-corrosion fatigue; Increased fatigue life due to surface protection.

UNIT -3

Creep

Mechanics of creep, inter-granular, trans-granular creep, Creep test, Creep strain rate-time curves, Deformation mechanism map; High temperature properties of materials; Long time creep-stress-time relations; Creep contribution to the fracture mechanism; Creep contribution to the fracture mechanism; DVM, DVL German-standard, Hatifield time yield test.

UNIT -4

Fracture

Damage tolerance analysis, residual strength in presence of cracks; Mechanisms of crack growth and fracture; Basic modes of fracture; Stress Concentration factor, state of stress at a stress concentration, load-flow-times; Measurement of Collapse strength; Griffith's theory of brittle fracture; Irwin's theory of fracture in elastic-plastic materials; Theories of linear elastic plastic fracture mechanics (LEFM); Stress intensity fracture, toughness, stress distribution at crack tip: plane stress, plane strain cases; Theories of elastic plastic fracture mechanics (EPFM); Crack opening displacement (COD) Criterion, COD tests, crack tip opening displacement (CTOD) measurement; Crack arresters; Implementation of fracture control.

UNIT -5

Design against Creep

Types of creep, Introduction to Design against creep. Combined creep and fatigue failure prevention.Shearby Dorn Parameter, Larson Miller Parameter, Menson- Haferd Parameter.

BOOKSRECOMMENDED:

[1]. Norman E. Dowling, "***Mechanical Behavior of Materials:Engineering Methods for Deformation, Fracture, and Fatigue***," 3rd edition, ***Pearson Prentice Hall,*** 2007.

[2]Shigley J.E. , "***Mechanical Engineering Design***"McGraw Hill 2003.

[3]Mubeen A. , "***Machine Design*** "Khanna Publications (P) Ltd

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Devi Ahilya University, Indore, India Institute of Engineering & Technology				1 Year M.E.(Design & Thermal Engg.) Full Time			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTR1E3 **Mechanism and Robot Kinematics**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: ***3 Hours***							

Objective and Pre requisites: The objective of the subject is to introduce the students about the basic analytical techniques and fundamental principles of Robot Kinematics. The Pre requisites are knowledge of the basic course in theory of machines, matrix theory, probability, computer programming and mathematical analysis.

COURSE CONTENT

UNIT-1

Introduction to Robotics & Mechanisms

Introduction, Automation and Robotics, Robot anatomy and Robot configurations, Links and joints notations, End effectors, Work volume and Obstacles, Overview of Robot drive systems and Control systems, Robot sensing, Dynamic performance and Precision of movement, Applications in Robotics.

UNIT-2

Robot Arm Kinematics

Introduction, Forward or direct Kinematics Problem, Matrix Representations, Robot arm coordinates and Transformation matrix, Composite homogeneous transformation matrix, Denavit-Hartenberg representation, Kinematic equations, Location of end effector, Inverse kinematic problem, Geometric approach for solution of inverse kinematic problem.

UNIT-3

Trajectory Planning

Introduction, Constraints and Path specifications, Basic algorithm for generation of joint trajectory, joint interpolated trajectories, Cartesian path trajectory planning.

UNIT-4

Robot Arm Control.

Fundamentals of control system theory, Joint motion controls: Servo mechanism, Computed torque technique, Minimum time control, Variable structure control. Adaptive control modes.

UNIT-5

Robot Programming and Task Planning

Introduction, Characteristics of robotic programming languages, position and motion specification, development and debugging facilities, task-level programming and robot program synthesis, Robot intelligence and task planning.

BOOKS RECOMMENDED:

[1] MikellP.Groover, *Industrial Robotics,* McGraw Hill Pvt. Ltd., New Delhi.
[2] K.S.Fu, R. C. Gonzalez, C. S.G. Lee, *Robotics: Control, Sensing, Vision and Intelligence,* McGraw Hill Book Company, Singapore, International Edition 1987.
[3] Robert J. Schilling, *Fundamentals of Robotics: Analysis & Control*, Prentice-Hall of India Private Limited, New Delhi, 5th Reprint, 2003

Subject Code & Name	Instructions Hours per Week			Credits			
DTR1E4 Thermal Systems : Simulation and Design	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: ***3 Hours***							

COURSE CONTENTS

Objective of the Subject:
The basic objective of the subject is to have goal of achieving a workable system and of designing an optimum system. The possibility of optimization represents one of the few facets of this subject.

Pre requsites: Thermodynamics, Heat & Mass Transfer.

UNIT- 1
Designing a Workable System and its Economics:
Steps in Arriving at a Workable System, Creativity in Concept Selection, Design of any Thermal Process Plant, Preliminaries to the Study of Optimization.

UNIT- 2
Dynamic Behaviour of Thermal Systems:
Dynamic Analysis, One Dynamic Element in a Steady State Simulation, Laplace Transformers, Inversion of Laplace Transforms, Feedback Control Loops, Time Constants Blocks, Cascaded Time Constant Blocks, Stability Analysis..

UNIT- 3
Modelling Thermal Equipment:
Using Physical Insight, Selecting vs Simulating a Heat Exchanger, Evaporators and Condensers, Condensation of a Binary Mixture, Overview of Search Methods, Assessment of Single Variable Searches.

UNIT-4
System Simulation:
Description of System Simulation, Uses of Simulation, Information Flow Diagrams, Sequential and Simultaneous Calculations, Taylor Series Expansion, Newton Raphson Method with Multiple Equations .

UNIT- 5
Optimization:
Levels of Otimization, Mathematical Representation of Optimization Problems, Linear Programming, Setting up the Mathematical Statement, Calculus Methods of Optimization, Expansion of Lagrange Multiplier Equations, Unconstrained Optimization.

BOOKSRECOMMENDED

[1] CengelYA.,***Heat Transfer-A Practical Approach,*** Tata McGraw Hill, New Delhi 2e,2002.
[2] Stoecker, WF. ***Design of Thermal Systems*** ,McGraw Hill International Editions, New Delhi**,** 2007
[3] Woodson,TT. ***Introduction to Engineering Design***, McGraw Hill, New York**,** 1996.
[4] Rudd, DF. ***Strategy of Process Design***, McGraw Hill, New York**,** 1996

SEM III				
1.	DTP3C1	Machinery Fault Diagnosis and Signal	3-1-1 =5	PC4

		Processing		
2.	DTP3C2	Advanced Refrigeration and Air Conditioning	3-1-1 =5	PC5
3.		***Generic Elective II***	3-1-0 =4	GE2
4.	DTP3V3	Comprehensive Viva III	0-0-2=2	
Total Credit for SEM III			**14 actual + 2 Virtual credits**	

COURSE CONTENTS

Objective & Pre requisites:

The basic objective of the subject is to deal with the analysis of faults generated inside the machine during the operations. The subject provides the basic knowledge of the methods used for the prevention of the faults and also the approach for analyzing the signals generated during the faulty condition of the machine. The Pre requisites are Tribology and Vibration.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				**M.E.(Design & Thermal) Part Time**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTP3C1 **MACHINERY FAULT DIAGNOSIS &SIGNAL PROCESSING**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

UNIT- 1

Introduction to Diagnostic Maintenance and Condition Monitoring:

Introduction to condition based maintenance, applications and economic benefits, signature analysis-online & offline technique, various condition monitoring techniques, levels condition monitoring, fault detection and diagnosis.

UNIT- 2

Fault Diagnosis using Vibration Monitoring:

Vibration monitoring and analysis, shock pulse methods, noise monitoring, envelope detection technique, types of vibration test, field balancing, case studies on vibration based condition monitoring.

UNIT- 3

Noise Monitoring & Control:

Introduction to noise, properties of noise, loudness and weighting networks, octave and FFT analysis, impulsive noise, instrumentation for noise measurement and analysis, sound power, sound intensity, noise source location, noise diagnostics, noise monitoring of machines with example, cepstrum analysis, noise control methods, maintenance and noise reduction, vehicle and machinery noise, noise standards, case studies.

UNIT-4

Advanced Methods of Condition Monitoring:

Oil analysis including wear debris and contaminant monitoring, performance monitoring, non-destructive techniques, IR-Thermography, ultrasonic monitoring, reliability centred maintenance, higher order spectrum/advanced signal processing.

UNIT- 5

Computer Aided Monitoring:

Application and choice of the methods, computer aided monitoring including experts system like artificial neural network, fuzzy logic and other optimizing techniques, practical applications and case studies on computer based condition monitoring.

BOOKS RECOMMENDED

[1] Ramamurthy V ,***Mechanical Vibration Practice with Basic Theory*** ,Narosa Publication House, New Delhi 1e,2002.

[2] Rao J S & Gupta K. ***Introductory Course on Theory and Practice of Mechanical Vibration*** ,New Age Publisher, New Delhi, 2e, 2002

[3] Rao J S, ***Vibratory Condition Monitoring of Machine***, Narosa Publishing House, New Delhi, 1e,2002.

[4] Mishra R C & Pathak K., ***Maintenance Engineering & Management***, Printice Hall of India, New Delhi, 1e , 2002.

[5] Gopalkrishnan P. & Banerji AB, ***Maintenance & Spare Part Management***, Printice Hall of India, New Delhi, 3e,2002.
[6] Hand Book of Condition Monitoring by BKN Rao, UK.

LABORATORY EXPERIMENTS:

1. Case studies based on vibration based condition monitoring.
2. Experimental analysis of Noise based condition monitoring.
3. Experimental analysis of faults using IR-Thermography .
4. Experimental analysis of faults using Non- Destructive methods.
5. Case studies on computer aided fault diagnosis.

List of Experiments

1. To measure the Elastic Modulus of Steel rod and Stainless Steel Wire.
2. To experimentally study the linear elastic behavior of beams under multi point loading.
3. To compare the stiffness of beams of the same length and cross-sectional area but having different profiles.
4. To measure the extensional strain in the top and bottom fibers of the beam specimens and compare with the prediction of engineering beam theory.
5. Introduction to Finite Element Analysis software.
6. To Solve 1D – Structural, thermal and fluid problems using FEA software.
7. To Solve Beam problems with different boundary and loading conditions using FEA software.
8. To Solve 2D problems using different element types in a FEA software. Also analyse effect of element formulation and number of elements.
9. To Solve 3D problems using FEA software.
10. To Solve Dynamic problems using FEA software.

Subject Code & Name	Instructions Hours per Week			Credits			
DTP3C2	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Advanced Refrigeration and Air Conditioning	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Objectives&Prerequisites: Advancements inRefrigeration and Air Conditioning Technologies. Fundamentals of Thermodynamics, Heat transfer, Refrigeration cycles, Psychrometry

COURSE CONTENT

UNIT-1

Advanced Vapour Compression Technologies:

Single Stage System; Multistage Refrigeration:Two-stage with given Intermediate Pressure, Optimum Interstage Pressure, Cascade Refrigeration System; Liquefaction of Gases: Linde–Hampson Cycle: Precooled Linde–Hampson Cycle; Claude's Cycle; Energy and Exergy analyses.

UNIT-2

Advanced Vapour Absorption and other Technologies

Vapor Absorption Systems: Ammonia-Water, Three fluid, Water-Lithium bromide;Solar-Powered Absorption Refrigeration System, Multi Stage Absorption Systems, Energy and Exergy analyses of Vapour Absorption Systems.

UNIT-3

Load Estimation and Air Conditioning Systems

Psychrometry, Psychrometric Processes, Load Estimation, Air-conditioning Systems: Classification-All Air, Air and water, All water Systems; Decentralized Cooling and Heating; Individual systems; Evaporative; Dessicant; Thermal storage; Clean room; Space systems; Packaged; Central systems

UNIT-4

Fans and Duct Design

Fans: Classification, Performance Characteristics and selection; Flow basics: Continuity Equation, Bernoulli's Equation, Flow head loss; Ducts: Types, pressure characteristics, system pressure loss; Duct design: Equal-friction, Constant-velocity method, Static regain method

UNIT-5

Controls

Control Loop and Control Methods;Control Modes: Two-position, Step and Modulating, Floating, Proportional; Proportional plus Integral (PI),Proportional-Integral-Derivative (PID); Controllers: Direct / Reverse acting, Pneumatic, electric, digital; Valves and actuator; Dampers

BOOKS RECOMMENDED:

1. W.F. Stoecker, ***Refrigeration and Air conditioning***, McGraw-Hill Book Company, 4e, 1985
2. Prasad M, ***Refrigeration and Air conditioning***, New Age International, 2e, 2011
3. Arora C P ***Refrigeration and Air conditioning***, McGraw-Hill Book Company, 1e, 1985
4. W.F. Stoecker, ***Refrigeration and Air conditioning***, McGraw-Hill Book Company, 1e, 1985
5. Shan Wang, ***Handbook of Air-Conditioning and. Refrigeration,*** McGraw-Hill Book Company, 2e, 2000
6. McQuiston F C., Parker J.D. and Spitler J. D., ***Heating, Ventilating, and Air-Conditioning Analysis and Design,*** John Wiley& Sons, 6e, 2005

LABORATORY EXPERIMENTS:

1. To calculate actual and ideal Coefficient of Performance of vapour compression trainer.
2. To calculate actual and ideal Coefficient of Performance of vapour Absorption System
3. To carry out various psychrometric process in Air-conditioning trainer.
4. To estimate the Heating and cooling load of an enclosure
5. To design a duct network for a given plan

SEM IV				
1.	DTP4C3	Computer AidedModeling and Simulation	3-1-1 =5	PC6
2.		***Elective II***	3-1-1 =5	PE2
3.	DTP4W2	Seminar/ Res. Tool/Work Shop-2	0-2-0=2	
4.	DTP4V4	Comprehensive Viva IV	0-0-2=2	
5.	ASP4S2	Soft Skills -2	2-0-0 =2	
Total Credit for SEM IV			**14 actual + 2 Virtual credits**	
List of Generic Elective II				
1.	**DTP3G1**	**Advanced Heat Transfer**		
2.	DTP3G2	Rapid Prototyping		
3.	DTP3G3	Cogeneration and Waste Heat Recovery		
4.	DTP3G4	Mechatronics in Manufacturing Systems		
List of Elective II				
1.	**DTP4E1**	**Machine Vibrations Analysis**		
2.	DTP4E2	Experimental Stress Analysis		
3.	DTP4E3	Applied Elasticity and Plasticity		
4.	DTP4E4	Automotive Systems: Analysis and Design		

Devi Ahilya University, Indore, India Institute of Engineering & Technology				**1 Year M.E.(Design&ThermalEngg.) Part Time**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DTP4C3 Computer Aided Modeling and Simulation	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: *3 Hours*							

Objectives:

To understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.

To model complex shapes including freeform curves and surfaces.

To understand various graphics standard for CAD data exchange (such as IGES, PARA etc).

To understand the application of Computers in Analysis and Design of Machine Elements.

Prerequisite:

COURSE CONTENT

UNIT - 1

INTRODUCTION

Fundamentals of CAD: Introduction: Design Process: Application of computers in design: Benefits of CAD. Computer Hardware: Graphic input devices; display devices; Graphic output devices; Central processing unit (CPU), Workstations.

UNIT- 2

COMPUTER GRAPHICS

CAD software and Database: Software configuration of a graphics system, Output primitives frame buffer – Bresenham's Algorithm – Line – Circle – function of graphics software - 2D & 3D transformation – Translation – scaling – Rotation – Homogeneous coordinate – Concatenation, clipping algorithm.

UNIT - 3

TECHNIQUES FOR GEOMETRIC MODELING

Geometric Modelling: Curves And Surfaces- Representation, Wire Frame models, Intrinsic and parametric representations, analytic and parametric curves and surfaces, Manipulations of curves and surfaces.

UNIT- 4

TECHNIQUES FOR GEOMETRIC MODELING AND DATA EXCHANGE STANDARDS

Geometric Modeling: Solids- Solid models, Fundamentals of Solid Modeling, Half -spaces, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Sweep Representation, Analytic Solid Modeling, Solid Manipulations.

Graphics standards – GKS, Data exchanger standards – IGES – STEP - DXF – Concept of data storage for solid models.

UNIT - 5

VISUAL REALISM

Introduction, Model Clean-up, Hidden Line Removal, Hidden Surface Removal, Hidden Solid Removal, Shading, Coloring and User Interface for Shading and Coloring,

Introduction to CAD Modeling Systems. Tolerance and Interference Analysis

Text Book:

[1.] Zeid Ibrahim and R Sivasubramanian,***CAD / CAM Theory and Practice,***2nd Edition, 3rd Reprint, 2010, TataMcGraw Hill Education Private Limited, New Delhi.

[2.] P N Rao, CAD/CAM Principles and Applications, 3rd Edition, 4th Reprint, 2011, TataMcGraw Hill Education Private Limited, New Delhi.

[3.] M Groover and E Zimmers, CAD/CAM Computer Aided Design and Manufacturing, 10th Impression, Pearson Education.

[4.] Krishnamoorathy C.S. and J.S. Rajeev, ***Computer Aided Design*** (Software and Analysis Tools), Narosa Pub House, New Delhi

Subject Code & Name	Instructions Hours per Week			Credits			
DTP3G1 Advanced Heat Transfer	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: 3 Hours							

Objectives&Pre requisites:
Advancements in the topics on Heat Transfer Engineering. Fundamentals of Thermodynamics, Heat transfer at Undergraduate level

COURSE CONTENT

UNIT-1
Steady State Unidirectional Heat Conduction with Heat Generation:
Heat flow through slab with heat generation, Heat flow through cylinder with heat generation, Dielectric heating, Heat conduction with heat generation when generation is a function of position, Heat conduction with heat generation when generation is a function of temperature, Steady state two dimensional heat conduction, Purpose of Insulation, Critical Radius of Insulation.

UNIT-2
Unsteady State Unidirectional Heat Conduction:
Unsteady state heating or cooling, Unsteady state heat conduction through finite slab with negligible thermal resistance, Unsteady state heat conduction through finite slab with thermal resistance, Heisler charts, Periodic heat flow.

UNIT-3
Thermodynamic Analysis of Heat Exchangers:
Introduction, Temperature distribution and heat flow, Overall heat transfer coefficient, Fouling of Heat Exchangers, Effectiveness method (NTU) to study the performance of Heat Exchangers, Second Law analyses of Counter and Parallel flow type Heat Exchangers (Exergy Analysis), Finite Time Thermodynamic (FTT) analyses of Heat Exchangers.

UNIT-4
Advanced Convection Principles
Conservation principles; Differential and Integral Equations of momentum and Energy for Laminar and Turbulent Boundary Layers; Heat Transfer in Laminar Internal and External Flows: Axial Variations of Surface temperature and Heat flux; Heat Transfer in Turbulent internal and External Flows.

UNIT-5
Advanced Radiation
Review of fundamentals; View factors: Definition and Evaluation, Area Integration, Contour Integration, View factor algebra, Inside sphere method, unit sphere method, Radiative Heat exchange between gray diffuse surfaces; solution methods for governing integral methods, Partially specular gray and nonidealsufaces.

BOOKS RECOMMENDED:

1. Bergman T.L., Lavine A. S., Incropera F. P. and Dewitt D. P. , ***Fundamentals of Heat And Mass Transfer,*** John Wiley & Sons, 7e, 2011
2. Kreith F., Manglik R. M., and Bohn M. S.,***Principles of Heat Transfer,***Cengage Learning, 7e 2011
3. Kays W., Crawford M., Weigand B., ***Convective Heat and Mass Transfer,*** McGraw-Hill Book Company, 4e, 2005
4. Modest M. F., ***Radiative Heat Transfer,*** McGraw-Hill, Inc. 1993
5. Bejan A, ***Convective Heat Transfer***, McGraw-Hill Book Company, 4e, 2005

Devi Ahilya University, Indore, India Institute of Engineering & Technology	M.E.(Design & Thermal) Part Time

Devi Ahilya University, Indore, India Institute of Engineering & Technology				I Year ME [PT] (Design & Thermal Engg.) Part Time				
Subject Code & Name	Instructions Hours per Week			Credits				
DTP3G2 **RAPID PROTOTYPING**	L	T	P		**L**	**T**	**P**	**Total**
	3	1	0		**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**								

Objective: To understand the basics of non-conventional prototyping processes.

COURSE OF CONTENT

UNIT-1

Basic operation, Role of Rapid Prototyping and tooling in product development and simultaneous engineering, Applications.

Rapid Prototyping Processes

Principles of RP processes, Classification, Laminated object manufacturing, Fused deposition modeling, Sterolithography, Solid ground curing, Selective laser sintering - 3D printing.

UNIT-2

CAD Requirements in RP

Introduction, Data requirements, Solid modeling, Surface modeling, Geometric processing, Interface formats, Model preparation, Slicing, Support structures and machine instructions

UNIT-3

Materials for Rapid Prototyping

Plastics, Resins, Metals, Ceramics, Selection of Materials for suitable processes, Advantages and limitations.

UNIT-4

Rapid Tooling Techniques

Rapid tooling techniques such as Silicone rubber molding, Epoxy molding, Electroforming, Vacuum casting, Vacuum forming, Laminated metallic tooling, Direct metal laser sintering.

UNIT -5

Rapid Manufacture

Introduction, Material and process controls for Rapid manufacture, Production economics, Implementation, Applications, automotive, aeronautical, space applications, additive manufacturing for construction industry, retail industry

Text Books

[1.] Pham, D.T., Dimov, S.S. (2001) Rapid Manufacturing, Springer-Verlag London Limited.

[2.] Neil Hopkinson, Richard Hague, Philip Dickens (Editors) Rapid Manufacturing: An Industrial Revolution for the Digital Age, Wiley Publication, 2005.

[3.] Rafiq I. Noorani, Rapid Prototyping: Principles and Applications, Wiley Publication, 2005.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				M.E.(Design & Thermal)			
Subject Code and Name	Instruction Hours per Week			Part Time		Credits	
DTP3G3 COGENERATION AND WASTE HEAT RECOVERY	L	T	P	L	T	P	Total
	3	1	-	3	1	-	4
Duration of Theory Paper: 3 Hours							

COURSE CONTENT

Objective & Pre requisites:

The objective of the subject is to provide an understanding of energy conservation in various thermal engineering applications. The Pre requisites are Thermodynamics, Fluid Mechanics and Heat Transfer.

UNIT- 1

Energy Usage and Conservation

Energy: forms and Conversion; Patterns of energy use; potential for energy conservation; optimum use of energy resources; total energy approach.

UNIT- 2

Thermodynamic Cycles and Cogeneration

Review of Various Thermodynamic cycles; Coupled cycles; Systems approach to a thermal engineering application based plants; combined plants and cogeneration systems.

UNIT- 3

Energy Storage

Energy Storage Systems: thermal electrical, magnetic and chemical energy storage systems, Need for energy storage; Utilization of industrial waste heat: gas-to-gas, gas-to-liquid and liquid-to-liquid heat recovery systems.

UNIT-4

Waste Heat Recovery

Heat Recovery systems; Recuperators and regenerators; heat pipes; waste heat boilers; fluidized bed heat recovery; shell and tube heat exchangers

UNIT- 5

Heat Recovery Sources

Sources of heat recovery; Prime mover exhausts; incineration plants; heat pump systems; thermoelectric devices. Utilization of low grade rejected heat from power plants.

BOOKS RECOMMENDED

[1] Reay, D. A., ***Heat Recovery Systems***, London, 1979.
[2] Boyce, M, P,. ***Handbook for Cogeneration and Combined Cycle Power Plants,*** ASME 2002
[3] Fin David, Cogeneration: A Users Guide, IET
[4] Daiment, ***Energy Systems***, Longman, UK

Subject Code & Name	Instructions Hours per Week			Credits			
	L	T	P	L	T	P	Total
DTP4E1 MACHINE VIBRATIONS ANALYSIS	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Objective of the subject: The objective of the subject is to deal with machine vibration analysis techniques and advanced areas of vibrations of machine elements based on Undamped and Damped Free Vibrations for single degree of freedom systems, Multi-degree of Freedom and Continuous Systems . Pre requisites are Theory of vibrations , Machine Design I and Machine Design II.

COURSE CONTENTS

UNIT-1

Review: Fundamentals of Vibration

Main causes, Advantages and Disadvantages. Vector method of representing Harmonic motion. Characteristics of vibration. Harmonic analysis. Beats Phenomenon. Work done by harmonic forces on harmonic motion. Periodic, non-harmonic functions: Fourier Series analysis, Evaluation of coefficients of Fourier series. Elements of vibratory system. Lumped and distributed parameter systems.

UNIT -2

Systems with single and two Degrees of Freedom

Forced harmonic vibration: vector representation of forces. Excitation due to Rotating and Reciprocating unbalance. Vibration isolation, Force transmissibility. Motion transmissibility: absolute motion of mass and relative motion of mass.

Undamped free vibrations and Principal Modes of vibration. Torsional vibrations. Forced Undamped vibrations with harmonic excitation.

UNIT -3

Systems with Multi-degree of Freedom and Continuous Systems.

Equations of motion.The Matrix method : Eigen values and eigen vectors. Vibration of Strings. Longitudinal vibrations of bars.Torsional vibrations of Circular Members. Transverse Vibrations of Beams.

UNIT -4

Determination of Natural Frequencies

Approximate methods of determining fundamental frequencies: Dunkerleys lower bound approximation and Rayleighs Method. Stodolas Method. The Holzers Method. The Method of Matrix Iteration, Envelop Analysis.

UNIT -5

Numerical Integration methods in Vibration Analysis

Introduction, Finite Difference Method, Runge-Kutta Method for single degrees of freedom systems, Houbolt method ,Finite Difference method for continuous systems.

BOOKS RECOMMENDED: Reference books:

[1] Thomson W.T., ***Theory of Vibration with Applications***, CBS Pub. And Distributors.
[2] Morse T., and Hinkle, ***Mechanical Vibration,*** Prentice Hall ofIndia Pvt. Ltd.
[3] Singiresu S. Rao, ***Mechanical Vibrations***, Pearson Education.,2005
[4] Ambekar A. G., ***Mechanical Vibrations and Noise Engineering*** , Prentice Hall of India Pvt. Ltd.,2006
[5] G. K. Grover, ***Mechanical Vibrations***, Nem Chand and Bros., Roorkee.

LABORATORY EXPERIMENTS:

6. Performance Analysis of single degree of systems.
7. Performance Analysis of two degree of systems.
8. Performance Analysis of multi degree of systems.
9. Study of vibration signature analysis methods
10. Study of vibration measuring instruments

Subject Code & Name	Instructions Hours per Week			Credits			
DTP4E2 EXPERIMENTAL STRESS ANALYSIS	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Subject Code & Name DTP4E3	Instructions Hours per Week			Credits			
Duration of Theory Paper:	L	T	P	L	T	P	Total
3 Hours							

COURSE CONTENTS

Objective & Pre requisites:

The basic objective of the subject is to deal fundamentals of stress analysis techniques. The subject is useful in understanding the behavior of material under the load and distribution of stress inside the material. The Pre requisites are material science, machine design and measurement and control.

UNIT- 1

Introduction:

Introduction to theory of elasticity. General principles governing the approach to experimental stress analysis technique. Principal of measurements. Accuracy, Sensitivity and range of measurement.

UNIT- 2

Polariscope& Extensometer:

Plain polariscope, circular polariscope, white light illumination, analysis of photoelastic data, Moira Method, Mechanism of formation of Moira fringe-geometrical approach to Moire fringe analysis-displacement field approach to Moire fringe analysis., Mechanical , Optical , Acoustical and Electrical extensometer and their uses, advantages and disadvantages.

UNIT- 3

Electrical Resistance Strain Gauge:

Principal of operation and requirement, types and their uses, Material of strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, strain gauge adhesive and mounting methods.

UNIT-4

Photoelasticity:

Two dimensional photoelasticity. Concepts of light-photo-elastic effects, stress optic law, Interpretation of fringe pattern, compensation and separation technique, photoelastic material, Introduction to three dimensional photoelasticity, digital photoelasticity, Effects of stressed model in a plane polariscope.

UNIT- 5

Non Destructive Testing:

Fundamentals of NDT, Radiography, Ultrasonic, Magnetic particle inspection, Fluorescent penetrate technique, Eddy current testing, Acoustic Emission Technique, Fundamentals of brittle coating methods, Holography, Ultrasonic, C-Scan, Thermography, Fibre optic Sensors.

BOOKS RECOMMENDED

[1] Dally J.W. and Riley, W.F. "***Experimental Stress Anaysis***" Mc Graw Hill Inc., New York, 1978
[2] Hetyenyi M " ***Hand Book of Experimental Stress Analysis***" John Wiley and Sons Inc. New York, 1972.
[3] Srinath L.S., Raghava M.R.,Lingaiah, K.Gargesha G, Pant B, Ramchendra K., " ***Experimental Stress Analysis***" Tata Mc Graw Hill, New Delhi., 1984
[4] Singh S. "***Experimental Stress Analysis***" Khanna Publication, 2001.
[5] Mubeen., Machin*e Design*, , Khanna Publica

Subject Code & Name	Instructions Hours per Week			Credits			
APPLIED ELASTICITY AND PLASTICITY	3	1	2	3	1	1	5

Duration of Theory Papers
3 Hours

Objective of the subject:

With this subject, the students get knowledge of the various Mechanical engineering materials property as well as behavior of material under Elastic & Plastic zone with different plane of surface.

Prerequisite(s): Strenght of Maerial, Material Science.

COURSE CONTENTS

UNIT - 1

Elasticity

Analysis of stress and strain relationship – Generalized Hook's law, Plane stress and plane strain problems, The state of strain at a point, Basic equations of elasticity, Methods of solution of elasticity problems.

UNIT- 2

Two-Dimensional Problems in Cartesian Co-Ordinates

Two dimensional problems in Cartesian and polar co-ordinates for simple problems, Airy's stress function, Bi harmonic equation, Saint Venant's Principle, Thick cylinder, Bending of curve bars , Simply supported rectangular beam under a triangular load, Fourier series, Complex potentials, Cauchy integral method , Fourier Transform Method, Real potential methods.

UNIT-3

Torsion of Non Circular Section

Methods of analysis, Membrane analogy, Torsion of thin rectangular section and hollow thin walled section, St. Venant's theory, Torsion of hollow cross-sections, Torsion of thin – walled tubes, Torsion of hollow bars, Analogous methods, Torsion of bars of variable diameter.

UNIT-4

Numerical and Energy Methods

Principle of Virtual Work-Energy theorem, Rayleigh Ritz method, Deflection of beams problems, Finite difference method, Rayleigh's method, Finite element method.

UNIT-5

Plasticity

Physical assumption , Mechanical models, Kelvin and Maxwell model, Viscous elasticity, Friction and Coulomb models, Parallel and Hybrid models, Applications, Criterion of Yielding, Yield surface, Flow rule, Elastic – Plastic problem in bending, Torsion and Thick cylinders, Introduction to Fracture mechanics, Wave propagation in plastic materials. Theory and application of slip line field, Bound theorem, Plastic anisotropic large deformation.

BOOKS RECOMMENDED:

[1] Timoshenko S., ***Theory of Elasticity***, Mc Graw Hill Book Co., Newyork1988.
[2]. Singh S, ***Theory of Elasticity***, Khanna Publishers, New Delhi.1988.
[3] Singh S., ***Theory of Plasticity,*** Khanna Publishers, New Delhi.1988.
[4] Chakrabarty J., ***"Applied Plasticity",*** Springer New Yark, 1st ed. 2000.
[5] Hoffman, ***"Theory of Plasticity",*** Mc Graw Hill, 2nd ed. 1985.
[6] Johnson, ***"Engineering plasticity",*** Van Nostrand, 1st ed. 1983.

DTP4E4 AUTOMOTIVE SYSTEM ANALYSIS & DESIGN	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Objective: The objective is to understand the principles and working of different systems of Automobiles & design principal & its applications.

Pre requisites: Machine Design and Strength of Material**.**

COURSE CONTENT

UNIT-1

Design for Tool Drive

Design of machine tools, machine tools motions, transmission-rotation in to rotation, rotation in to translation, kinematic-structures of machine tools: elementary, complex and compound structure elementary, complex and compound structure, kinematic-features of gear shapers and gear hobbing machine.

UNIT-2

Transmission System

Requirements Clutches, Toque converters, Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber, Steering geometry, Ackerman mechanism.

UNIT-3

Electrical and Control Systems

Types of storage battery, Construction and operation of lead acid battery, Testing of battery, Principle & operation of starting mechanism, Electric fuel gauge, Fuel pump, Horn, Wiper, Lighting system, Head light dazzling, Signaling devices and circuit, Battery operated vehicles. Microprocessor based control system for automobiles, Car air conditioning systems and components, Indian standards for automotive vehicles exhaust emission Bharat and Euro norms, Indian Motor vehicle act- preliminary information.

UNIT-4

Chassis and Body Engineering

Chassis classification, Types of frames, Vehicle body types & construction, Body materials, Driver's visibility and methods for improvement, Safety aspects of vehicles, Location of engine, Front wheel and rear wheel drive, Performance of Vehicle.

UNIT-5

Suspension System

Vehicle Dynamics and requirement of suspension , Suspension types & construction, Shock absorber, Types of leaf springs coil spring, Air spring, Torsion bar, Location of shackles, Brakes-classification & construction, Mechanical, Hydraulic & Pneumatic power brake systems, Air-bleeding of Hydraulic brakes, ABS, Performance- Braking efforts, Efficiency, Stopping Distance & time, tendency of over turning.

BOOKS RECOMMENDED:

[1] Singh Kirpal, Automobile Engineering, Vol.1, Standard Pub, 9e.
[2] Giri N.K., Automotive Technology, Khanna Pub, 4e 2009.
[3] Newton & Steeds, Automobile Engineering, Butterworth Int.
[4] Heitner Joseph, Automotive Mechanics, Principles and Practices, East-West Pub.
[5] Crouse W.H., Automotive series Part-I to VI, Tata McGrawhill, 9e.

SEM V			
DTP5D1	Dissertation Phase I	0-0-12=12	
DTP5V5	Comprehensive Viva V	0-0-4=4	

Total Credit for SEM V		**12 actual + 4 Virtual credits**	
SEM VI			
DTP6D2	Dissertation Phase II	0-0-12=12	
DTP6V6	Comprehensive Viva VI	0-0-4=4	
Total Credit for SEM VI		**12 actual + 4 Virtual credits**	
Total Credits		**80 actual + 16 Virtual credits**	