JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
DEPARTMENT OF MECHANICAL ENGINEERING
M. Tech. (ENGINEERING DESIGN)
2019-20 Admitted Batch

I SEMESTER

Semester – I						
S. No	Course Type/ Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Core –1	Advanced Mechanics of Solids	3	1	0	4
2.	Core- 2	Advanced Mechanics of Machinery	3	1	0	4
3.	Core -3	Mechanical Behavior of Engineering Materials	3	0	0	3
4.	Programme Elective –I	Theory of Elasticity Computer Aided Design Random Vibrations	2	0	0	2
5.	Programme Elective –II	Optimization Techniques and Applications Vehicle Dynamics Design for Manufacturing and Assembly	2	0	0	2
6.	Core Lab –I	Advanced Dynamics Lab	0	0	3	1.5
7.	Core Lab - II	Advanced Material Testing lab	0	0	3	1.5
8.	Audit Course-I	English for Research Paper Writing	2	0	0	0
Total Credits						**18**

II SEMESTER

S. No	Course Type/ Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Core –4	Advanced Machine Design	3	0	0	3
2.	Core- 5	Advanced Finite Element and Boundary Element Methods	3	0	0	3
3.	Core -6	Advanced Robotics	3	0	0	3
4.	Programme Elective –III	Vibration Analysis of Mechanical Systems Neural Networks and Fuzzy Logics Advanced Tool Design	2	0	0	2
5.	Programme Elective –IV	Experimental Stress Analysis Fracture Mechanics Applied Tribology	2	0	0	2
6.	Core Lab –III	Advanced Computer Aided Modeling Lab	0	0	3	1.5
7.	Core Lab - IV	Advanced Computer Aided Analysis Lab	0	0	3	1.5
8.	Audit Course-II	Value Education	2	0	0	0
9.	Mini Project with Seminar		0	0	4	2
Total Credits						**18**

III SEMESTER

S. No	Course Type/ Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Programme Elective –V	Geometric Modeling	3	0	0	3
		Concurrent Engineering				
		Design for Process and Product Development				
2.	Open Elective	Composite Materials	3	0	0	3
		Waste to Energy				
3.	Dissertation	Dissertation Phase - I	0	0	20	10
Total Credits						**16**

Semester – IV						
S. No	Course Type/ Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase - II	0	0	32	16
Total Credits						**16**

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Advanced Mechanics of Solids

(Core –1)

L	T	P	C
3	1	0	4

Prerequisite: Applied Mechanics, Mechanics of solids

Course Objectives: This course is concerned with the development of analytical methods for solving problems in mechanics of materials that are generally considered beyond the scope of basic course in the discipline.

Course outcomes: After completing this course, the student should be able to

- Determined the point of location of applied load to avoid twisting in thin sections used in aerospace applications.
- Understand the concept of distinguish between neutral and centroidal axes in curved beams.
- Understanding the analogy models developed for analyzing the non circular bars subjected to torsion, and also analyzing the stresses developed between rolling bodies and stress in three dimensional bodies.

UNIT–I:
Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending, Deflection of straight beams due to nonsymmetrical bending.

UNIT–II:
Curved beam theory: Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

UNIT–III:
Torsion: Linear elastic solution Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section, Hollow thin wall torsion members, Multiply connected Cross Section.

UNIT–IV:
Contact stresses: Introduction, problem of determining contact stresses, Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses, Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact) Loads normal to area, Stresses for two bodies in line contact, loads normal and Tangent to contact area.

UNIT–V:
Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatic bar by its own weight twist of circular shafts of constant cross section, pure bending of plates.

Text Books:

1. Advanced Mechanics of materials by Boresi & Side Bottom, Wiely International.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw, Hill Publishers 3rd Edition

Reference Books:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates by Timoshenko.
3. Strength of materials & Theory of structures by B.C Punmia (Vol I & II)
4. Strength of materials by Sadhu singh

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Advanced Mechanics of Machinery

(Core –2)

L	T	P	C
3	1	0	4

Prerequisite: Kinematics of machinery

Course Objectives: The overall objective of this course is to learn how to analyze the motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines. To find radius of curvature of polodes

Course outcomes: After completing this course, the student should be able to

- Understand the kinematic analysis of rolling bodies based on graphical, geometrical and analytical methods.
- Design of mechanisms by using graphically and analytically by involving function generator, rigid body guidance and path generation(Coupler curve) methods

UNIT–I:

Advanced Kinematics of plane motion- I: Introduction to plane motion. Euler – Savary Equation, the Inflection circle, Analytical and graphical determination of d_i, Bobillier's Construction, Collineation axis, Hartmann's Construction, Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT–II:

Advanced Kinematics of plane motion - II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Freudenstein's Collineation – axis theorem, Carter –Hall circle.

UNIT–III:

Introduction to Synthesis-Graphical Methods - I: The Four bar linkage, Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle, Guiding a body through Four distinct positions: Burmester's curve.

UNIT–IV:

Introduction to Synthesis-Graphical Methods - II: Function generation- General discussion, Function generation: Overlay's method, Function generation- Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT–V:

Introduction to Synthesis - Analytical Methods: Function Generation: Freudenstien's equation, Precision point approximation. Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

Text Books:

1. Kinematics and Dynamics of plane mechanisms by Jeremy Hirschhorn, McGraw-Hill, 1962.
2. Theory of Mechanisms and Machines by Amitabh Ghosh and Ashok Kumar Mallik, E.W.P. Publishers.

Reference Books:

1. Kinematics and Linkage Design by Allen S.Hall Jr., PHI, 1964.
2. Theory of Machines and Mechanisms by J.E Shigley and J.J. Uicker Jr., McGraw-Hill, 1995.
3. A Robot Engineering Text book by Mohsen Shahinpoor, Harper & Row Publishers, New York, 1987.
4. Analysis of mechanisms and Robot manipulators by Joseph Duffy, Edward Arnold, 1980

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Mechanical Behavior of Engineering Materials

(Core –3)

L	T	P	C
3	0	0	3

Prerequisite: Physical Metallurgy

Course Objectives: The main objectives are to provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multi-axial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear

Course outcomes: After completing this course, the student should be able to

- Understand the different modes of failures like fracture, fatigue and creep of ductile and brittle materials

UNIT-I:
Fracture: Introduction, Types of Fracture in Metals, Griffith Theory of Brittle Fracture, Fracture of Single Crystals, Ductile Fracture, Concept of the Fracture Curve.

UNIT-II:
Fracture Mechanics: Strain Energy Release rate, Fracture Toughness and Design, Crack Opening Displacement, J-Integral, R Curve.

UNIT-III:
Fatigue-I: Introduction, Stress Cycles, S-N Curve, Effect of Mean Stress on Fatigue, Cyclic Stress strain curve, Low Cycle Fatigue, Strain Life Equation, Structural Features of Fatigue, Fatigue Crack Propagation, Effect of Metallurgical Variables on Fatigue.

UNIT-IV:
Fatigue-II: Effect of stress concentration on Fatigue, Size Effect, Surface effects on Fatigue, Fatigue under Combined stresses, Design for Fatigue, Machine Design approach-Infinite life design, Local strain approach, Corrosion Fatigue, Effect of Temperature on fatigue.

UNIT-V:
Creep deformation: The evolution of creep damage, primary, secondary and tertiary creep, Micro mechanisms of creep in materials and the role of diffusion, Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters, Creep-fatigue interactions, Examples.

Text Books

1. Mechanical Metallurgy by G. E. Dieter, McGraw Hill, (1988)
2. Thin Film Materials L.B. Freund and S. Suresh, Cambridge University Press (2003).

Reference Books:

1. Fracture Mechanics Fundamentals and Applications by T.L. Anderson, 2nd Ed. CRC press, (1995)
2. Fracture of Brittle Solids by B. Lawn, Cambridge Solid State Science Series 2nd ed1993.
3. Fundamentals of Fracture Mechanics by J.F. Knott, Butter worths (1973)
4. Worked examples in Fracture Mechanics by J.F. Knott, P Withey, Institute of Materials.

5. Fracture Mechanics by H.L.Ewald and R.J.H. Wanhill, Edward Arnold, (1984).
6. Fatigue of Materials by S. Suresh, Cambridge University Press, (1998)
7. Inelastic Deformation of Metals by D.C. Stouffer and L.T. Dame, Wiley (1996)
8. The Physics of Creep by F.R.N. Nabarro, H.L. de Villiers, Taylor and Francis, (1995)

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Theory of Elasticity

(Programme Elective –I)

L	T	P	C
2	0	0	2

Prerequisite: Mechanics of solids

Course objectives:

The objectives of this course are to introduce graduate and senor undergraduate's students to advanced topics in linear elasticity. Students will build on the knowledge gained through all mechanical related courses of the undergraduate curriculum (statics, mechanics of materials etc)

Course outcomes: After completing this course, the student should be able to

- Deriving the governing equations for 2D and 3D elastic problems.
- Solve these problems with various solution methodologies.

UNIT-I:

Introduction: Elasticity – notation for forces and stress components of stresses - components of strain - Hooks law. Plane Stress and plain strain analysis - plane stress - plane strain- differential equations of equilibrium - boundary conditions – compatibility equations –stress function - boundary condition.

UNIT-II:

Two dimensional problems in rectangular co-ordinates-solution by polynomials - Saint-vanant's principle-determination of displacements-bending of simple beams-application of Fourier series for two dimensional problems-gravity loading.

UNIT-III:

Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates – displacements - displacement for symmetrical stress distribution - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates - application of general solution in polar coordinates.

UNIT-IV:

Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses - max shear stresses - homogeneous deformation - principal axes of strain rotation. General Theorems. Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solutions - the reciprocal theorem.

UNIT- V:

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars-solution of torsional problems by energy method - use of soap films in solving torsion problem - hydro dynamical analogies - torsion of shafts, tubes, bars etc.

Text Books:

1. Theory of Elasticity by Timeshanko, Mc Grawhill Publications

Reference Books:

1. Theory of Elasticity by Y.C. Fung.
2. Theory of Elasticity by Sadhu Singh. Dhanpat Rai sons Private Limited, New Delhi

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Computer Aided Design

(Programme Elective –I)

L	T	P	C
2	0	0	2

Pre-requisites: Basic computer skills, drafting and blueprint reading, elementary machine shop, Engineering technical mathematics

Course objectives:

To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD.

Course Outcomes:

Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components .To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT–I:

Fundamentals of CAD, Automation , Design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, and definitions of cubic spline, Bezier, and B-spline.

UNIT-II:

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT–III:

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT–IV:

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

UNIT–V:

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Text Books:

1. CAD/CAM Principles and Applications by P.N.Rao, TMH
2. CAD/CAM Concepts and Applications by Alavala, PHI

Reference Books:

1. CAD/CAM by Groover M.P., Pearson education
2. CAD/CAM Theory and Practice, by Ibrahim Zeid, TMH
3. CAD/CAM/CIM by Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing by Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming by Warren S Shames, Thomson.

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Random Vibrations

(Programme Elective –I)

L	T	P	C
2	0	0	2

Prerequisites: Probability & Statistics, Kinematic of machinery and Dynamics of machinery.

Course Objectives : The main objective of course is to present fundamentals to a modern treatment of vibrations, placing the emphasis on analytical developments and computational solutions. This course will provide the detail knowledge about nonlinear and random vibration with fault diagnosis of machinery using vibration signature analysis.

Course outcomes: After completing this course, students should be able to

- Apply tools from probabilistic modeling to analyze dynamic systems while accounting for variability and uncertainties that are inevitably present in real engineered systems.
- Classify random excitations as stationary or non-stationary
- Discuss important properties of random processes
- Define and compute power spectral density functions
- Compute auto-and cross-correlation functions, and relate them to power spectral
- Density functions Describe the dynamic response of a multi-degree-of-freedom system to a stochastic excitation
- Quantify the distributions of peak loads and peak responses from a system subject to stochastic excitation

UNIT-I:
PROBABILITY THEORY: Random Vibrations - Probability distribution and density functions - Excreted values - Conditional probability - Characteristic and log characteristic functions - Chebyshev inequality - Functions of random variables.

UNIT–II:
RANDOM PROCESSES - I: Concept of stationary and ergodicity - Evolutionary nono stationary process - Auto and cross correlation and covariance Functions - Mean square limit, differentiability and inerrability - Spectral decomposition.

UNIT-III:
RANDOM PROCESSES - II: Power spectral and cross spectral density Factions - Wiener - Khintchine relations - Properties of Gaussian. Poisson and Markov processes –Fokker - Planck Equation - Broad band and narrow band random processes - white noise.

UNIT-IV:
RANDOM VIBRATIONS - I: Response of linear single and multi - degree of freedom systems to stationary excitation - Response of continuous systems - Normal mode method.

UNIT-V:
RANDOM VIBRATIONS - II: Level crossing, peak and envelop statistics - First excursion and fatigue.

Text Books:

1. Probabilistic Methods in the Theory of Structures by Lishakoff, I John Wiley, New York, 1983.
2. An Introduction to Random Vibrations and Spectral Analysis by Newland and D.E Longman Inc., New York, Second Edition, 1984.

Reference Books:

1. Introduction to Random Vibrations by Nigam, N.C., MIT Press, Cambridge, Massachusettes, 1983.
2. Applications of Random Vibrations by Nigam, N.C. and Narayanan, S., Narosa Publications, 1995.

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Optimization Techniques and Applications

(Programme Elective –II)

L	T	P	C
3	1	0	4

Prerequisites: Operations Research

Course Objectives: The main objectives of the course are:

- Numerical optimization techniques for single variable and multi variable non- linear optimization problems.
- Sensitivity analysis on LPP queuing
- Simulation of annexing problem & inventory problem.
- Geometry cutting plane method & branch bound method for linear IPP.
- Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm.
- Formulation of GP model and solving it using arithmetic geometric inequality theorem.
- State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes: At the end of the course, the student is able to apply appropriate optimization techniques and solve.

- Based on the type of optimization problem like single variable or multivariable,
- Make sensitivity analysis to study effect of changes in parameters of LPP on the optimal solution without reworking.
- Simulate the system to estimate specified performance measures.
- Solve integer programming problem by either geometry cutting plane algorithm or branch band method.
- Apply chance constrained algorithm and solve stochastic linear programme.
- Formulate GP model and solve it.
- Solve given optimization problem by genetic algorithm or simulated annealing or PSO.

UNIT-I:

Single Variable Non-Linear Unconstrained Optimization: Elimination methods: Uni-Model function-its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

UNIT-II:

Multi variable non-linear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hook -Jeeves, Rosenbrock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT-III:

Linear Programming – Formulation, Simplex method & Artificial variable optimization techniques: Big M & Two phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition of variables, constraints. Simulation – Introduction – Types-steps – applications: inventory & queuing – Advantages and disadvantages

UNIT-IV:

Integer Programming- Introduction – formulation – Geometry cutting plane algorithm – Zero or one algorithm, branch and bound method

Stochastic Programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

UNIT-V:

Geometric Programming: Posynomials – Arithmetic - Geometric inequality – unconstrained G.P-constrained G.P (≤ type only)

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO) (very brief)

Text Books:

1. Optimization theory & Applications by S.S.Rao, New Age International.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

Reference Books:

1. Operations Research by S.D.Sharma
2. Operation Research by H.A.Taha, TMH
3. Optimization in operations research by R. LRardin
4. Optimization Techniques by Belugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M.C. Joshi, K.M.Moudgalya, Narosa Publications

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Vehicle Dynamics

(Programme Elective –II)

L	T	P	C
3	1	0	4

Prerequisite: Automobile Engineering

Course Objectives:

- The students should be able to understand multi-body system approach to vehicle dynamics.
- The student should be able to use 2-D computational software to solve vehicle dynamics problems

Course Outcomes: At the end of the course the students will be able to

- The focus of Automotive System Dynamics is to introduce the fundamentals of vehicle dynamics and the performance indices and evaluation criteria of vehicles, to analyze the influence of vehicle configuration and design parameters on vehicle performance.

UNIT-I:

Introduction: Fundamental Principles, Vehicle tires performance, cornering characteristics, Mechanics of Vehicle Terrain interaction. Vehicle Kinematics, Fundamental principles of velocity, acceleration. Two dimensional mechanisms, Forward Vehicle Dynamics.

UNIT-II:

Three dimensional Mechanisms, Multi-Body Systems Design, Introduction to 3D vehicle design.

UNIT-III:

Suspension Design: Computer models using Bond Graph Technology, Drive train dynamics, vehicle performance

UNIT-IV:

Steering Mechanisms: Two and three dimensional analysis, Mechanics of Vehicle Terrain interaction. Vehicle Collations, Fundamental laws of motion, energy and momentum, Forces and Moments 2D and 3D. The Dynamics of vehicle rollovers.

UNIT-V:

Wheeled Vehicle Handling – Handling control loop, vehicle transfer function, Kinematic behavior of vehicles with rigid wheels and with complaint tyres: Neutral steer point, static margin, over and under-steer. Solution with two degree of freedom in the steady state: Stability factor, characteristic and critical speeds. Tracked Vehicle Handling – Analysis of sprocket torques and speeds, required to skid steer a tracked vehicle. Extension of theory to include three degrees of freedom.

Text Books:

1. Vehicle Dynamics Theory and Application by Reza Jazar, Springer 2008
2. Theory of Ground Vehicles by J.Y.Wong, John Wiley.

Reference Books:

1. Vehicle stability by Dean Karnopp, Dekker Mechanical Engineering
2. Modeling & Simulation of Mechatronics Systems by Karnoop Margolis, Rosenberg, Wiley 2007.
3. Suspension and Tyres by Giles J.G. Steering, Illiffe Books Ltd., London.
4. Fundamental of Vehicle Dynamics by Gillespie T.D, SAE USA.

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Design for Manufacturing and Assembly

(Programme Elective –II)

L	T	P	C
3	1	0	4

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives: The objective of course is identify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.

Course Outcomes: At the end of the course, the student will be able to:

- Understand the quality aspects of design for manufacture and assembly
- Apply Boothroyd method of DFM for product design and assembly
- Apply the concept of DFM for casting, welding, forming and assembly
- Identify the design factors and processes as per customer specifications
- Apply the DFM method for a given product

UNIT-I:

Introduction: Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design.

Materials: Selection of Materials for design – Developments in Material Technology – Criteria for material selection – Material selection interrelationship with process selection – process selection charts.

UNIT-II:

MACHINING PROCESS: Overview of various machining processes – general design rules for machining - Dimensional tolerance and surface roughness – Design for Machining ease – Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts.

METAL CASTING: Appraisal of various casting processes, Selection of casting process, General design considerations for casting – casting tolerances – Use of Solidification Simulation in casting design – Product design rules for sand casting.

UNIT-III:

METAL JOINING: Appraisal of various welding processes, Factors in design of weldments – General design guidelines – pre and post treatment of welds – Effects of thermal stresses in weld joints – Design of brazed joints.

FORGING – Design factors for Forging – Closed die forging design – parting lines of dies – Drop forging die design – General design recommendations

UNIT-IV:

EXTRUSION, SHEET METAL WORK & PLASTICS: Design guidelines for Extruded sections - Design principles for Punching, Blanking, Bending, Deep Drawing – Keeler Goodman Forming Limit Diagram – Component Design for Blanking.

PLASTICS: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

UNIT-V:

DESIGN FOR ASSEMBLY : General design guidelines for Manual Assembly - Development of Systematic DFA Methodology - Assembly Efficiency - Classification System for Manual handling- Classification System for Manual Insertion and Fastening - Effect of part symmetry on handling time - Effect of part thickness and size on handling time - Effect of weight on handling time - Effect of symmetry , Further design guidelines.

Text Books:

1. Engineering design-Material & Processing Approach by George E. Dieter, Mc. Graw Hill Intl. 2nd Ed.2000.
2. Product design for Manufacture and Assembly by Geoffrey Boothroyd, Marcel Dekker Inc. NY, 1994.

Reference Books:

1. Product design and Manufacturing by A.K Chitale and R.C Gupta, Prentice, Hall of India, New Delhi, 2003.
2. Design and Manufacturing by Surender Kumar & Goutham Sutradhar, Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
3. Hand Book of Product Design by Geoffrey Boothroyd Marcel Dekken Inc. NY, 1990.
4. Product Design by Kevin Otto and Kristin Wood, Pearson Education

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Advanced Dynamics Lab

(Core Lab –I)

L	T	P	C
0	0	3	1.5

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

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Advanced Material Testing lab

(Core Lab –II)

L	T	P	C
0	0	3	1.5

1. Determination of tensile strength of PMC / MMC
2. Determination of flexural strength of PMC/MMC
3. Determination of wear characteristics of PMC / MMC
4. Determination of fracture toughness of MMC using fatigue test
5. Study of fracture surface of different materials tested under UTM, fatigue test
6. Determination of Hardness of PMC/MMC using micro hardness testing machine
7. Determination of thermal conductivity of PMC / MMC
8. Determination of water absorption in PMC.
9. Synthesis of a polymer composite
10. Synthesis of a semiconductor nano-particles by chemical method
11. Preparation of metal oxide semiconductor thin film
12. Determination of optical absorption characteristics

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
COLLEGE OF ENGINEERING HYDERABAD, DEPARTMENT OF MECHANICAL ENGINEERING
M. Tech. (ENGINEERING DESIGN), I SEMESTER

English for Research Paper Writing

(Audit Course-I)

L	T	P	C
2	0	0	0

Course objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	**4**
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.	**4**
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**4**
4.	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	**4**
5.	Skills are needed when writing the Methods, Skills needed when writing the Results, Skills are needed when writing the Discussion, Skills are needed when writing the Conclusions	**4**
6.	Useful phrases, how to ensure paper is as good as it could possibly be the first – time submission	**4**

Suggested Studies:

1. Goldbort R(2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
5. Highman M (1998P), Handbook of Writing for the Mathematical Seiences, SIAM. Highman's Book
6. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Machine Design

(Core –4)

L	T	P	C
3	0	0	3

Prerequisite: Design of Machine Elements

Course Objectives:

- To study design concepts in order to enhance the basic design.
- To study behaviour of mechanical components under fatigue and creep.
- To study statistical techniques and its applications in mechanical design.

Course outcomes: After completing this course, the student should be able to

- Ability to analyze behaviour of mechanical elements under different loads
- Understand the design of different transmission elements of automobile
- Ability to analyze mechanical elements critically.

UNIT-I:

Shafts and Axles: Introduction, Causes of failure in Shafts and Axles and Stresses in Shafts, Materials for Shafts and Axles, Methods of Manufacturing of Shafts, Designing of Straight Shafts, Pure Torsional Load, Designing for Rigidity and Stiffness, Design of Axles, Flexible Shafts.

UNIT-II:

Rope drive: Fibre ropes, rope drives for power transmission, fibrous Ropes used in Hoisting Tackle, Wire Ropes, Materials, Wire Rope Construction, Applications of Ropes, properties of various types of Ropes, Approximate wire Diameters and Effective Cross- section of Ropes: Fiber cores for steel wire ropes, Working loads, Friction and Efficiency wire rope, sheaves and Drum, rope fasteners, Selection of wire rope, design procedure.

UNIT-III:

Chain drives: Types of Chain drives, construction of Chains, Roller Chains, Silent Chains, selection of a chain, Design of the chain Drive, Good design practice.

UNIT-IV:

Gear drives: Design calculations for helical gears, Definitions, double helical , Gear tooth proportions, Design calculations, forces acting in a Bevel gear, Worm gear drives, worm wheel, designation of a worm gear drive, Materials, efficiency of Drive, Heat Dissipation, Design of worm Gearing, Forces on worm gears, advantages and disadvantages of worm gear drives.

UNIT-V:

Power screws: Friction, Types of Power screws, Multiple threads, Comparison of square and trapezoidal threads, Power screw drive, Efficiency of screws, square threads, Trapezoidal Threads, stresses in screws design calculations, design procedure, other types of screws, differential and compounds screws, ball baring screws.

Text Books:

1. Machine Design by Dr. P.C. Sharma, S.K.Kataria & sons
2. Machine Design by Maleev and Hartman, C.B.S Publishers

Reference Books:

1. Machine Design by Schaum series
2. Mechanical Engineering design by J.E. Shigley

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Finite Element and Boundary Element Methods

(Core –5)

L	T	P	C
3	0	0	3

Prerequisite: Strength of Materials, Mathematics, Heat Transfer and Vibrations.

Course Objectives:

- To Introduce the basic concepts of the finite element method, the boundary element method
- To discuss the advantages and limitations of each method
- To Demonstrate the capabilities of each method on a variety of problems

Course outcomes: After completing this course, the student should be able to

- Understand the background of mathematical equations used for development of modeling software modules to develop the various structural related applications
- Identify mathematical model for solution of common engineering problems.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.

UNIT–I:

One Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions.

Analysis of Trusses: Derivation of Stiffness Matrix for Trusses, Stress and strain Calculations, Calculation of reaction forces and displacements.

Analysis of Beams: Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

UNIT–II:

Finite element – formulation of 2D Problems: Derivation of Element stiffness matrix for two dimensional CST Element, Derivation of shape functions for CST Element, Elasticity Equations, constitutive matrix formulation, Formulation of Gradient matrix. Two dimensional Isoparametric Elements and Numerical integration.

Finite element – formulation of 3D problems: Derivation of Element stiffness matrix for Tetrahedron Element, Properties of Shape functions for 3D Tetrahedral Element, Stress-Strain Analysis for 3D Element, Strain Displacement for Relationship Formulation.

UNIT–III:

Steady state heat transfer analysis: One Dimensional Finite Element analysis of fin and composite slabs. **Two dimensional steady state heat transfer problems:** Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST, Derivation of thermal force vector for 2D heat transfer problems.

Dynamic Analysis: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

UNIT–IV:

Plate Bending: Introduction – Plate behavior – C^1 (Kirchoff) Plate elements – C^0 (Mindlin) Plate elements – Mindlin beam – More devices for C^0 Plate elements – Boundary conditions - Analytical problems.

Nonlinear finite element of solids: Material Nonlinearities, objective rates, nonlinear elasticity, Plasticity, viscoplasticity, viscoelasticity

UNIT–V:

Boundary Element Method: Potential Problems: Introduction, boundary Element Approach- Fundamental solution. Numerical Implementation - Determination of Ci, Final Relation, Three-dimensional analysis, tackling kernel singularity.

Boundary Element Formulation for Electrostatic Problems: Introduction, Basic Relation- Boundary condition, other relations. Discretization and Matrix Formulation – Determination of term $C(p)_m$.

Text Books:

1. Finite and Boundary Element Methods in Engineering by O.P.Gupta, Oxford & IBH Publishing Co. Pvt. Ltd
2. The finite element methods in Engineering by S.S. Rao, Elsevier, 4^{th} edition

Reference Books:

1. Finite Element Methods by Alavala, PHI.
2. Introduction to Finite Elements in Engineering by Tirupathi K. Chandrupatla and Ashok D. Belagundu.
3. An Introduction to Finite Element Methods by J. N. Reddy, Mc Grawhill
4. The Finite element method in engineering science by O.C. Zienkowitz, Mc Grawhill.
5. Concepts and Applications of Finite Element Analysis by Robert Cook, Wiley

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Robotics

(Core –6)

L	T	P	C
3	0	0	3

Prerequisites: Kinematics of machinery

Course Objectives:

- To Demonstrate knowledge of different types of actuators used in robotic systems.
- To Analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To Analyze the dynamics of a robot arm, implement in 2D.
- To Analyze sensor signals to implement real-time control algorithms.
- To Demonstrate knowledge of error propagation in electrical, mechanical and computational systems.
- To Construct, program, and test the operation of a robotic system to perform a specified task.

Course Outcomes: After doing this course, the student should be able to,

- Understand the evolution, classification, structures and drives for robots.
- Teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- Expose the students to build a robot for any type of application.

UNIT-I:

Introduction: Automation and Robotics, Robot anatomy configuration, motions joint motion and notation, work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:

Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT-III:

Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV:

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT-V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

Text Books:

1. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
2. Industrial robotics by Mikell P.Groover, McGraw Hill.

Reference Books:

1. Industrial robotics by Mikell P.Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
5. Robot Analysis and Control by Asada H. and J. E

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Vibration Analysis of Mechanical Systems

(Programme Elective –III)

L	T	P	C
2	0	0	2

Prerequisite: Basic concepts of Physics

Course Objectives:

- To understand the fundamentals of Vibration Theory
- To be able to mathematically model real-world mechanical vibration problems

Course Outcomes: At the end of the course the students will be able to

- To study the vibrations in machine elements and how to control them.
- Ability to analyze the mathematical model of linear vibratory system to determine its response
- Obtain linear mathematical models of real life engineering systems
- Determine vibratory responses of single and multi degree of freedom systems to harmonic, periodic and non-periodic excitation

UNIT-I:

Free Vibration of Single Degree of Freedom Systems: Introduction, Free Vibration of an Undamped Translational System, Equation of Motion using Newton's second law of motion, Equation of motion using other methods, Equation of motion of a spring, mass system in vertical position, solution, Harmonic Motion Free Vibration of an Undamped Torsional System- Equation of motion. Free Vibration with Viscous Damping- Equation of motion.

UNIT-II:

Forced Vibration of Single Degree of Freedom Systems: Introduction, Response of an Undamped system under harmonic force, Total response, Beating Phenomenon. Response of a Damped System under Harmonic Force- Total Response, Quality Factor and Bandwidth, Response of a Damped system under the Harmonic Motion of the base, Fore Transmitted, Relative Motion.

UNIT- III:

Two Degree of Freedom Systems: Introduction, Equations of Motion for forced Vibration, Free Vibration Analysis of and undamped system, Torsional system, Coordinate Coupling and Principal Coordinates, forded Vibration Analysis, Semi definite Systems, Self- Excitation and stability Analysis.

UNIT-IV:

Multi-degree of Freedom Systems: Introduction Modeling of Continuous systems as Multi-degree of Freedom systems, Using Newton's second law to derive equations of motion, Influence Coefficients. Potential and kinetic energy expressions in matrix form, Generalized coordinates and generalized forces, Using Lagrange's equations to derive equations of motion, Equations of motion of undamped systems in matrix form, Eigen value problem, solution of the Eigen value problems – solution of the characteristic equation, orthogonality of normal modes, repeated Eigen values.

UNIT-V:

Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's Method- Properties of Rayleigh's Quotient, Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts. Holzer's Method-Torsional systems, Spring Mass Systems. Jacobi method, Standard Eigen value Problems.

Text Books:

1. Mechanical Vibrations by S.S.Rao, 4th Edition, Pearson Publications.
2. Elements of Vibration Analysis by Meirovitch.

Reference Books:

1. Mechanical Vibrations by G.K. Groover.
2. Vibrations by W.T. Thomson
3. Mechanical Vibrations by Schaum series.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Neural Networks and Fuzzy Logics

(Programme Elective –III)

L	T	P	C
2	0	0	2

Prerequisite: Operations research, Optimization Techniques**,** Control Systems

Course Objectives: The goal of this course is to give a good basic understanding of Neural Networks and Fuzzy Logic. This course is mainly intended for engineers who desire to learn more about these techniques

Course outcomes: After completion of this course, the student should be able to

- Learn concepts of neural networks and fuzzy logics
- Understand the topology of multi-layer perceptron, recurrent neural networks and
- Fuzzification & Defuzzification.
- understand the basic structure and operation of Fuzzy logic control systems

UNIT-I:
Evolution of neural networks; Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline.

UNIT–II:
Topology of Multi-layer perceptron, Back propagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen's self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

UNIT–III:
Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

UNIT–IV:
Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy
arithmetic; composition and inference; Considerations of fuzzy decision-making.

UNIT-V:
Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

Text Books:

1. Neural Networks in Computer Intelligence by Limin Fu, McGraw Hill, 2003.
2. Soft Computing and Intelligent Systems Design, Theory, Tools and Applications by Fakhreddine O. Karray and Clarence De Silva., Pearson Education, India, 2009.

Reference Books:

1. Fuzzy Logic with Engineering Applications by Timothy J. Ross, McGraw Hill, 1995.
2. Artificial Neural Networks by B.Yegnanarayana, PHI, India, 2006.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Tool Design

(Programme Elective –III)

L	T	P	C
2	0	0	2

Prerequisite: Production technology

Course Objectives:

- To reveal the essential properties, selection and recent progress in cutting tool materials.
- To select suitable single point cutting tool and multipoint cutting tool for machining process.
- To develop skill on design Jigs and Fixtures for holding tool and work price respective.
- To create expertise in press tool design and fixtures.

Course Outcomes: At the end of the course the students will be able to

- Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools apply the design procedures for different types of design problems such as gear box design, guide way
- Design, shaft loading and its associated parts, rolling bearings, die design and jigs and fixtures and so on.

UNIT-I:

Tool Materials: Properties of materials, Tool steels, Cast Iron, Mild or low carbon steels, Non-metallic and nonferrous materials, Heat treating.

Design of Cutting Tools: Single point cutting tools, Milling cutters, Drills, Selection of carbide steels.

UNIT-II:

Determination of shank size for single point carbide tools, determining the insert thickness for carbide tools.

Design of Jigs and Fixtures: Basic principles of location and clamping; Locating methods and devices. Jigs – Definition, Types.

UNIT-III:

General considerations in the design of Drill jigs, Drill bushing, Methods of Construction. Fixtures – Vice fixtures, Milling, Boring, Lathe Grinding fixtures.

Design of Sheet Metal Blanking and Piercing Dies: Fundamentals of Die cutting operations, Power press types, General press information, Material Handling equipment.

UNIT-IV:

Cutting action in Punch and die operations. Die clearance, Types of Die construction. Die design fundamentals – Blanking and piercing die construction, pilots, stripper and pressure pads presswork material, Strip layout, Short run tooling for piercing.

UNIT-V:

Design of Sheet Metal Bending, Forming and Drawing Dies: Bending dies, Drawing dies, Forming dies, Drawing operations, Variables that effect metal flow during drawing. Determination of blank size, Drawing force, single and double action draw dies.

Text Books:

1. Tool Design by Donaldson, Tata Mc Graw Hill.
2. Mechanical Metallurgy by George E Dieter, Tata McGraw Hill

COLLEGE OF ENGINEERING HYDERABAD, DEPARTMENT OF MECHANICAL ENGINEERING
M. Tech. (ENGINEERING DESIGN), II SEMESTER

Experimental Stress Analysis

(Programme Elective –IV)

L	T	P	C
2	0	0	2

Prerequisite: Strength of Materials, Theory of Elasticity desirable

Course objectives:

To provide an introduction to the basic principles and methods of experimental stress analysis that includes enhancive treatment of the most versatile teaching like photo elasticity and strain gauges. It also provides the sin different experimental teaching such as more brittle coatings, thermo elastic stress analysis and NW time.

Course Outcomes: At the end of the course the students will be able to

- Know the working principle of strain gauges and do the model analysis using different theorems.
- Know the concepts of photo elasticity and its applications.
- Use the various Non-destructive testing methods.

UNIT-I:

Strain Gauges - Mechanical and optical strain gauges – Description and operation –Electrical resistance-Inductance and capacitance gauges – Detailed treatment on Resistance gauges – Measurement of static and dynamic strains – Strain rosettes – Effect of transverse strains – Use of strain recorders and load cells.

UNIT-II:

Model Analysis - Structural similitude – Use of models – Structural and dimensional analysis – Buckingham Pi Theorem – Muller Breslau's principle for indirect model analysis – Use of Begg's and Eney's deformeters – Moment indicators – Design of models for direct and indirect analysis.

UNIT-III:

Two dimensional photo elasticity - Stress optic law – Introduction to polariscope – Plane and circular polariscope – Compensators and model materials – Material and model fringe value – Calibration of photo elastic materials – Isochromatic and isoclinic fringes – Time edge effects.

Unit-IV:

Three dimensional photo elasticity - Introduction – Stress freezing techniques – Stress separation techniques – Scattered light photo elasticity – Reflection polariscope.

Unit-V:

Miscellaneous Methods - Brittle coating method – Birefringence techniques – Moire fringe method – Non-destructive testing – Ultrasonic pulse velocity technique – Rebound hammer method – X-ray method – Gamma-ray method.

Text Books:

1. Experimental stress analysis by Dally and Riley, Mc Graw-Hill

Reference Books:

1. Experimental stress analysis by Sadhu singh, Danapathi rai publications
2. Handbook of Experimental Stress Analysis by Heteny M, John Wiley and Sons, New York.
3. Photo elasticity by Frocht M.M., Vol. I & II, John Wiley and Sons, New York.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Fracture Mechanics

(Programme Elective –IV)

L	T	P	C
2	0	0	2

Prerequisite: Strength of Materials, Theory of Elasticity desirable.

Course Objectives:

- Acquire fundamental understanding of the fracture of solid materials.
- Develop detailed understanding of fracture mechanics, creep, and fatigue.
- Obtain fundamental knowledge of corrosion and environmentally-assisted cracking.
- Acquire basic understanding of the techniques used to perform failure analysis.

Course Outcomes: At the end of the course the students will be able to

- Predict material failure for any combination of applied stresses.
- Estimate failure conditions of a structure
- Determine the stress intensity factor for simple components of simple geometry
- Predict the likelihood of failure of a structure containing a defect

UNIT-I:
Introduction to fracture Mechanics: The Crack Tip Plastic Zone, Methods for Measuring Fracture Toughness.

UNIT-II:
Strength of cracked bodies- potential energy and surface energy – Griffith's theory – Irwin – Orwin extension of Griffith's theory to ductile materials – Stress analysis of cracked bodies – Effect of thickness on fracture toughness – Stress intensity factors for typical geometries.

UNIT-III:
PHYSICAL ASPECTS OF FATIGUE:
Phase in fatigue life - Crack initiation – Crack growth - Final fracture - Dislocation – Fatigue fracture surfaces. Safe Life and Fail safe design philosophies Importance of Fracture Mechanics in Aerospace structure – Applications to composite materials and structures.

UNIT-IV:
STATICAL ASPECTS OF FATIGUE BEHAVIOUR:
Low cycle and high cycle fatigue - Coffin- Manson's Relation –Transition Life – Cyclic strain hardening and softening – Analysis of load histories – Cycle counting techniques – Cumulative damage – Miner's theory, other theories.

UNIT-V:
Dynamic Fracture, Stress Corrosion Cracking, Corrosion Fatigue, Fatigue - Crack Propagation under Variable - Amplitude Load Fluctuation, Fatigue - Crack Initiation, Fatigue - Crack Propagation under Constant - Amplitude Load Fluctuation.

Text Books:

1. Introduction to Fracture Mechanics by Hellan K, McGraw Hill
2. Fracture Vol II by Liebowitz, H.Editor, Academic Press
3. The Practical Use of Fracture Mechanics by Broek.D, Kluwer Academic Publisher.
4. Elementary Engineering Fracture Mechanics IV th Edition– Broek.D, Martinus Nijhoff.

Reference Books:

1. Fatigue of Aircraft Structures by Barrpos. W., and Ripley, E.L., Pergamon Press, Oxford, 1983.

2. Mechanics of Fracture by Sih, C.G., Vol. 1 Sijthoff and Noordhoff International Publishing Co., Netherlands, 1989.
3. Fundamentals of Fracture Mechanics by Knott, J.F., Butterworth & Co., (Publishers) Ltd., London. 1983.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Applied Tribology

(Programme Elective –IV)

L	T	P	C
2	0	0	2

Prerequisite: Design of machine members, Fluid Mechanics

Course Objectives:

- To Explain the processes of lubrication in all regimes
- To Explain the friction phenomena
- To Select a suitable lubricant for a specific application
- To Select a suitable material combination for tribological contacts
- To Determine the risk of wear by using simple analyses
- To Suggest an explanation to the cause of a tribological failure

Course outcomes: After completing this course, the student should be able to

- Understand the different types of lubrications and relevant theories used in supporting elements.
- Understand the failure mechanisms in different types of supporting elements.

UNIT–I:
Selection of rolling element bearings: Nominal life, static and dynamic capacity - Equivalent load, probabilities of survival -cubic mean load - bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT–II:
Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number - performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings - fixed tilting pads, single and multiple pad bearings - optimum condition with largest minimum film thickness.

UNIT–III:
Hydrostatic Bearings: Thrust bearings – pad coefficients - restriction - optimum film thickness - journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

UNIT–IV:
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.
Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants - additives - lubrication systems and their selection – selection of pump, filters, piping design - oil changing and oil conservation.

UNIT–V:
Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferro graphy. Factors to be considered for life enhancement.

Text Books:

1. Hydrostatic and Hybrid bearing design by Rowe WW& O' Dionoghue, Butterworths & Co. Publishers Ltd, 1983.
2. Mechanical Fault diagnosis and condition monitoring by Collacott R.A, Chapman and Hall, London 1977.
3. Fundamentals of fluid film lubricant by Bernard J.Hamrock, Mc Graw-Hill Co., 1994.

Reference Books:

1. Tribology hand Book by Neale MJ, (Editor), Neumann Butterworths, 1975.
2. Standard hand book of lubrication engineers by Connor and Boyd JJO (Editors) ASLE, Mc Graw Hill Book & Co., 1968.
3. Mechanical Engineering Design by Shigley J, E Charles, McGraw Hill Co., 1989.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Computer Aided Modeling Lab

(Core Lab –III)

L	T	P	C
0	0	3	1.5

Prerequisite: CAD, FEM

Course Outcomes: At the end of the course the students will be able to

- Students should be able to use CATIA and Pro-E and software for modeling, tolerance & GD&T analysis of a product.
- Students should be able to use CATIA software to model a consumer product and industrial robot.

DRAFTING:

1. Development of part drawings for various components in the form of orthographic and isometric.

PART MODELING:

1. Generation of various 3D Models through pad, shaft, shell sweep.
2. Feature based and Boolean based modeling surface and Assembly Modeling. Design simple components.
3. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
4. To make an isometric dimensional drawing of a connecting rod.
5. Draw Different type's bolts and nuts with internal and external threading in Acme and Square threading standards. Save the bolts and nut as blocks suitable for insertion.
6. To model and assemble the flange coupling as per the dimensions given and also convert the 3D model into different views
7. To model and assemble the Screw jack as per the dimensions given and also convert the 3D model into different views.
8. To model and assemble the strap joint of Gib & cotter as per the dimensions given and also convert the 3D model in to different view.
9. Various Dimensioning and tolerancing techniques on typical products using CAD software.
10. Simulation of Kinematic Mechanism using MS Adams Package

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Advanced Computer Aided Analysis Lab

(Core Lab –IV)

L	T	P	C
0	0	3	1.5

Prerequisite: CAD, FEM

Course Outcomes: At the end of the course the students will be able to

- Students should be able to carry out structural, Harmonic and fracture analysis using FEA software for real time applications.

Note: Conduct any **Ten** exercises from the list given below:

1. Analysis of Framed structures using FEA software.
2. Perform Fracture analysis for simple problem using FEA software.
3. Analysis of laminated composite structures using FEA software.
4. Perform a simple modal analysis for a cantilever beam using FEA software.
5. Perform Harmonic analysis for a given cantilever beam using FEA.
6. Perform a simple transient analysis for different beams.
7. **Non-Linear Analysis:** Find the geometric non linearity behavior for a cantilever beam subjected to a large moment.
8. **Buckling analysis:** Solve simple buckling problems using eigen value and non linear methods
9. Stress analysis of a rectangular plate with a circular hole.
10. Thermal Analysis of 1D & 2D problem with conduction and convection boundary conditions. (Minimum 4 exercises)
11. Design optimization of unknown parameters for a given beam.
12. Use of contact elements to simulate two given beams when they are in contact with each other.
13. **Flow Over a Flat Plate:** Solve a classical flat plate 2-D air flow problem
14. **Using Coupled Structural/Thermal Analysis:** solve a simple structural/thermal problems
15. **Substructuring**: Solve a simple problems using Substructuring method in ANSYS.
16. **Melting Using Element Death**: Using element death procedure model melting of a material.

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M. Tech. (ENGINEERING DESIGN), II SEMESTER

Value Education

(Audit Course-II)

L	T	P	C
2	0	0	0

Course Objectives: Students will be able to

1. Understand value of education and self-development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Syllabus

Unit	Content	Hours
1.	• Values and self-development-Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non-moral valuation. Standards and principles	4
	• Value judgements	
2.	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism. Love for nature, Discipline	6
3.	• Personality and Behavior Development – Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of Self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4.	• Character and Competence-Holy books vs Blind faith • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence, Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

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M. Tech. (ENGINEERING DESIGN), III SEMESTER

Geometric Modeling

(Programme Elective –V)

L	T	P	C
3	0	0	3

Prerequisites: CAD/CAM

Course Objectives:

- Learn modeling curves (B-splines and Bezier)
- Learn modeling Bezier and B-spline surfaces
- Familiarity with NURBS
- Familiarity with advanced techniques such as subdivision and reconstruction
- Mastery of object construction and manipulation methods including lofting, surface of revolution, and tubularization.
- Mastery of Reconstruction from PCD and Mesh generation

Course Outcomes: After doing this course, the student should be able to do

- 2D & 3D transformations
- Develop cubic splines, Bezer curves and B-spline curves
- Write equations of surfaces, quadratic surfaces and analyze mathematically

UNIT–I:
Geometrical Modeling: Introduction, History, Geometrical representation, Linear Algebra Boolean Algebra, Vectors, Matrices, Equations for curves- Intrinsic and Explicit ,parametric equations of curves, conic curves and points on curves, Problems

UNIT–II:
Transformations: 2-D and 3D Transformations, translation, Rotation, Homogeneous space, Scaling, stretching, Mirror reflection, Composite Transformations and problems

UNIT–III:
Cubic Splines: Algebraic and geometric force of cubic spline, parametric space of a curve, blending functions, Problems
Bezier Curves: Berustein's polynomials, equations, control points, convex hull property, truncating and subdividing composite and Rational Bezier curves, Problems
B-Spline Curves: Uniform and non-uniform B-Spline basis functions, quadratic and cubic B-spline basis functions, NURBS, Problems

UNIT–IV:
Surfaces: Explicit and Implicit equations of surfaces, quadratic surfaces, parametric equation of surfaces, Curve Nets and Embedded Curves, Generation, Mathematical Analysis, Applications of Bezier and B-Spline Surfaces, Surface patches. Problems

UNIT–V:
Solids: Parametric and Tricubicsolids, sweep solids, Topology of models, graph and boolean based models. Constructive solid Geometry (CSG), B-rep models. Problems; Feature modeling, rendering, lighting, animation.

Text Books:

1. Geometric Modeling by Micheal E. Mortenson, Third Edition, McGraw Hill Publishers
2. CAD/CAM concepts and Applications by Alavala, PHI

Reference Books:

1. Curves and surfaces for CAGD, Fifth Edition by Gerald Farin, Elsevier, India
2. Computer Graphics by Alavala, PHI, New Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
4. Elements of Computer Graphics by Roger & Adams, Tata McGraw Hill.

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Concurrent Engineering

(Programme Elective –V)

L	T	P	C
3	0	0	3

Prerequisites: Computer-Aided Design

Course objective: To provide a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support.

Course Outcomes:

- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Design assembly workstation using concepts of simultaneous engineering.
- Design automated fabricated systems – Case studies.

UNIT-I:

Introduction: Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

Use Of Information Technology: IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

UNIT-II:

Design Stage: Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design.

Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

UNIT-III:

Manufacturing Concepts and Analysis: Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system.

UNIT-IV:

JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

Project Management: Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost.

UNIT-V:

Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

Text Books:

1. Concurrent Engineering: Automation Tools and Technology by Andrew Kusaik, Wiley John and Sons Inc., 1992.

Reference Books:

1. Integrated Product Development by Anderson MM and Hein, L. Berlin, Springer Verlog, 1987.
2. Design for Concurrent Engineering by Cleetus, J.Concurrent Engineering Research Centre, Morgantown W V, 1992.

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Design for Process and Product Development

(Programme Elective –V)

L	T	P	C
3	0	0	3

Prerequisite: Engineering Science

Course Objectives: The objective of this course is to introduce the students about the basic product design process based on mechanical aspects applying innovative thinking and fundamentals of mechanical engineering.

Course Outcomes:

- Confidence to create new product based on mechanical design engineering.
- Students will have knowledge of all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
- Students will have ability to solve open-ended problem belongs to design engineering that meet the requirements.
- Students will have ability to understand contemporary issues and their impact on provided solution

UNIT- I:
Introduction to Product Design, Product Development Versus Design, Types of Design and Redesign, Customer Satisfaction- Voice of the Customer, Customer Populations , types of Customer Needs, Customer Need Models, Gathering Customer Needs Need Gathering Methods, Organizing and Prioritizing Customer Needs, Grouping Interpreted Needs, Grouping the Needs- Affinity Diagram Method.

UNIT- II:
Establishing Product Function - Why Functional Decomposition? Motivation, Function Modeling Basics, Functions and Constraints, Modeling Process.

UNIT- III:
Generating Concepts, Concept Generating Process, Basic Methods; Information Gathering and Brainstorming, Information Gathering – Conventional Aids, Traditional Brainstorming, Advanced Methods, Directed search, systematic search with physical principles, systematic search with classifying schemes, theory of inventive problem solving, Morphological Analysis - Develop concepts for each product function, Combining Solution Principles - Digression - function sharing, Product Application fingernail clipper, Concept Selection - Introduction, Factors that determine effective decision making, design evaluations, information quality, estimating technical risibility, concept selection process.

UNIT- IV:
Environmental Objectives, global issues, Regional and Local issues. Basic DFE Methods; Design Guidelines, application. Life cycle assessment, weighted sum assessment methods. Life cycle assessment method. Techniques to reduce environmental impact - design to minimize material usage, design for disassembly design for recyclability and design for remanufacturing design for high - impact material reduction design for energy efficiency.

UNIT- V:

Physical Models and Experimentation: Design of experiments - basic of designed experiments, basic method - two factorial experiments , extended method – interactions, Design of experiments: Reduced tests and fractional experiments, full factorial inefficiencies, orthogonality, base design method, Higher dimensions fractional factorial designs. Stastical analysis of experiments - degrees of freedom, correlation coefficient.

Design for Robustness: Quality design theory, general robust design model, robust design model construction. Basic method: Taguchi's method, noise variable matrix, design variable matrix, experimental matrix, single to noise ratios, selection of a target design, parameter design and the Taguchi philosophy. Advantage analysis - Probability Theory Sizing the variation, general robust design Problem formulation.

Text Books:

1. Integrated product and process design and development by Edward B.Magrab, Satyandra K Gupta et al, CRC Press, 2nd Edition.
2. Engineering Design by George E. Dieter, Linda C. Schmidt, McGraw- Hill, International Edition, 4th Edition

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Composite Materials

(Open Elective)

L	T	P	C
3	0	0	3

Prerequisite: Structure and properties of composite materials and design procedures for composite structures

Course objectives:
To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching and to predict the elastic properties of both long and short fiber and understand the stress-strain relations and establish the failure criteria for laminated structures.

Course Outcomes: At the end of the course the students will be able to

- Understanding of types, manufacturing processes, and applications of composite materials.
- Basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- Ability to analyze problems on macro and micro mechanical behavior of lamina
- Ability to analyze problems on macro mechanical behavior of laminate
- An ability to predict the loads and moments that cause an individual composite layer and a composite laminate to fail and to compute hygro thermal loads in composites.
- An ability to compute the properties of a composite laminate with any stacking sequence.

UNIT-I:
Introduction to Composite Materials: Introduction ,Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

UNIT-II:
Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT-III:
Macro mechanical Analysis of a Lamina: Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT-IV:
Macro mechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates.

UNIT-V:

Failure, Analysis, and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues.

Text Books:

1. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K.Kaw, Publisher: CRC.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.

Reference Books:

1. Analysis and performance of fibre Composites by B. D. Agarwal and L. J. Broutman, Wiley- Inter science, New York, 1980.

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Waste to Energy

(Open Elective)

L	T	P	C
3	0	0	3

Prerequisite: An introductory knowledge of solid and hazardous waste along with some basic understanding of solid waste management at industries

Course Objectives:

- To Prepare the students for successful career in the energy industry, energy service companies, energy utility and consultancy agencies and in the academ ic and R&D institutions.
- To produce graduates strong in understanding on energy resources, technologies and syste ms, energy management fundamentals, and capable in innovative technological interventio n towards the present and potential future energy issues.
- To produce energy professionals, who are sensitive to, and well aware of, the energy iss ues and concerns, and who can apply their specialized knowledge for the sustainable develop ment.

Course Outcomes:

Understood and acquired
fundamental knowledge on the science and engineering of energy technologies and systems. Acquired the expertise and skills required for energy auditing and management, economical calcu lation of energy cost, development, implementation, maintenance of energy systems.
Become capable of analysis and design of energy conversion systems, Acquired skills in the scientific and technological communications and preparation, planning and implementation of energy projects.

UNIT-I:

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste – MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT-II:

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal- Methods – Yields and application- Manufacture of pyrolytic oils and gases, yields and applications. Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and updraft gasifiers- Fluidized bed gasifiers- Design, construction and operation- Gasifiers burner arrangement for thermal heating- Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-III:

Biomass Combustion: Biomass stoves- Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidized bed combustors, Design, construction and operation- Operation of all the above biomass combustors.

UNIT-IV:

Biogas: Properties of biogas (Calorific value and composition)- Biogas plant technology and status- Bio energy system – Design and constructional features- Biomass resources and their classification- BIOMASS CONVERSION PROCESS.

UNIT-V:

Thermo chemical conversion – Direct combustion – biomass gasification- pyroloysis and liquefaction- biochemical conversion- anerobic digestion- Types of biogas Plants- Applications- Alcohol production from biomass- Bio diesel production- Urban waste to energy conversion- Biomass energy programme in India.

Text Books:

1. Non Conversional Energy by Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology – A Practical Hand Book by Khandelwal, K.C and Mahdi, S.S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books:

1. Food, Feed and Fuel from Biomass by Challal, D.S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology by C.Y. WereKo- Brobby and E.B. Hagan, John Wiley & Sons, 1996.