

Branch Name:	Mechanical Engineering
Semester/Year:	Semester VI / Third Year
Subject Title:	Computer Aided Design
Subject Code:	1ET1010604
Pre-requisite:	Machine Design

Course Objectives:

1. To develop computer algorithm for design and analysis of mechanical systems.
2. Understand mathematical aspects of geometrical modeling.
3. To develop computer algorithm for design and analysis of mechanical systems.
4. Understand and use finite element methods for analysis of simple components.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	04	70	30	30	20	150

Subject Contents			
Sr. No	Topic	Total Hours	Weightage (%)
1	Fundamentals of CAD: Introduction, Conventional and computer aided design processes, Product Life Cycle and Role of CAD, Applications of CAD, Reasons for implementing a CAD system, Input/ Output devices, Technical specification of CAD workstation. Computer Graphics: Refresh display, DVST, Raster display. Concept of Line and Curve generation algorithm: DDA, Bresenham's algorithms, Working Coordinate System, Model Coordinate System, Screen Coordinate System.	06	15
2	Geometric Transformations: 2D Transformations: Translations, Rotation, Scaling and Reflection. 3D Transformations: Translations, Rotation, Scaling and Reflection. Homogeneous Coordinates, Orthographic and Perspective Projections, Windows to View port transformation, Clipping.	06	15
3	Curves and Surfaces: Parametric representation of lines: Locating a point on a line, parallel lines, perpendicular lines, distance of a point, Intersection of lines. Parametric representation of circle, Ellipse, parabola and hyperbola. Synthetic Curves: Concept of continuity, Cubic Spline: equation, properties and blending. Bezier Curve: equations, properties; Properties and advantages of B-Splines and NURBS.	08	20

	Various types of surfaces along with their typical applications.		
4	Mathematical representation of solids: Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation.	03	05
5	Finite Element Analysis: Types of elements, types of error, derivation equation for various types of analysis, Basic steps in FEM, applications of FEA, stress-strain relation and generalized Hooke's Law, Plane stress and Plane strain conditions, Concept of total potential energy, properties of stiffness matrix, shape functions and characteristics, Basic equations of elasticity. 1-D Analysis: Concept of Shape function and natural coordinates, strain - displacement matrix, derivation of stiffness matrix for structural problems, properties of stiffness matrix. 1-D structural problems with elimination and penalty approaches, 1-D thermal and fluid problems. Trusses and Beams: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members. Structural analysis using Euler-Bernoulli beam element.	20	45

Course Outcomes:

The student will be able to

1. Understand and appreciate use of computer in product development.
2. Operate CAD packages to prepare solid model of components, assemble them to represent complex mechanical systems.
3. Apply knowledge of mathematical concept for geometry manipulation and modeling of curves, surface and solids.
4. Understand and use finite element methods for analysis of simple components.

5. List of Reference Books:

1. Zeid, Ibrahim. CAD/CAM theory and practice. McGraw-Hill Higher Education, 1991.
2. Chandrupatla, Tirupathi R., et al. Introduction to finite elements in engineering. Vol. 2. Upper Saddle River, NJ: Prentice Hall, 2002.
3. Mortenson, Michael E. "Geometric modeling." (1997).
4. Rogers, David F., and J. Alan Adams. Mathematical elements for computer graphics. McGraw-Hill Higher Education, 1989.
5. Farin, Gerald E. Curves and surfaces for CAGD: a practical guide. Morgan Kaufmann, 2002.

List of Practical:

1. Introduction to CAD tools and hardwires.
2. Programming exercises for point, line, and circle plotting
3. Hands on practice on 3-D modeling.
4. Hands on practice for assembly modeling.
5. Introductory exercise for finite element analysis.
6. Hands on practice for structural problems.
7. Hands on practice for trusses.
8. Hands on practice for beam element.
9. Hands on practice for 1-D thermal problems.
10. Hands on practice for 1-D fluid problems.

E-Resources:

<http://nptel.ac.in/courses/112104031/12>