ME386: COMPUTER AIDED DESIGN
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

1. Impart the knowledge of geometric modeling techniques and its manipulation.
2. Outline the techniques of finite element analysis.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				
L	T	P	C	Theory		Practical		Total Marks
				ESE	CE	ESE	CE	
3	0	2	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** Product life cycle and CAD tools for its design process, CAD/CAM integration and its evaluation criteria, CAD workstation: Hardware and Software Coordinate systems: Working coordinate system, Model coordinate system, Screen Coordinate system Scan conversion algorithms for line and circle: DDA and Bresenham's algorithm Graphics exchange standards and Database management systems.	06
2	**Geometric Transformations:** Homogeneous representation; Translation, scaling, rotation, reflection and shear transformation in 2D and 3D, Composite transformations; Orthographic and perspective projections. Window to View-port transformation.	05
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, Hermite cubic spline: equation, properties and blending. Bezier Curve: equations, properties; Properties and advantages of B-Splines and NURBS. Introduction to various types of surfaces along with their typical applications.	07

Unit No.	Topics	Teaching Hours
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, ASM, Primitive instancing, Cell Decomposition and Octree encoding.	04
5	**Applications of CAD:** Need and importance of solid and surface models for Interference detection, Assembly modeling, finite element analysis, computer aided part programming, computer aided process planning, Automated layout and drafting and computer aided manufacturing	04
6	**Introduction to FEA:** Review of stress-strain relation and generalized Hooke's Law, Plane stress and Plane strain conditions; Concept of Total Potential Energy; Basic procedure for solving a problem using Finite Element Analysis. 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: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members.	17
	Total Hrs.	**43**

List of References:

1. Ibrahim Zied, CAD / CAM: Theory and Practice, McGraw-Hill
2. Hearn E J and Baker M P, Computer Graphics, Pearson.
3. Chandrupatla T A and Belegundu A D, Introduction to Finite Elements in Engineering, PHI.
4. Logan D, A First Course in the Finite Element Method, Cengage.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Apply the knowledge of computer skill in product development and develop algorithms to display geometric entities.
2. Compute transformations of geometric entities.
3. Employ parametric representations of curves and surfaces.
4. Illustrate representations of solid modeling techniques.
5. Apply surface and solid models to real life engineering problems.
6. Illustrate basics of finite element analysis.