3ME04: COMPUTER AIDED DESIGN
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

1. To apply geometric modeling techniques for mechanical design and analysis.
2. To outline the techniques of finite element analysis.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
L	T	P	C	Theory Marks		Practical Marks		Total Marks
				ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction:** A typical product cycle, CAD and CAE tools for the design process of product cycle, CAD / CAM integration. Graphics exchange standards and Database management systems.	04
2	**Geometric Transformations:** Representation of points, Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing, transformations about an arbitrary point/axis/plane in space, and concatenations in 2D and 3D; Orthographic and perspective projections. Window to View-port transformation.	05
3	**Geometric Modelling of Curves and Surfaces:** Non-parametric and parametric representation of curves, parametric representation and generation of line:Locating a point on a line, parallel lines, perpendicular lines, distance of a point, Intersection of lines; circle, ellipse, parabola, hyperbola, Synthetic curves: concept of continuity, Hermite cubic spline: equation, properties and blending. Bezier curves: blending function, properties, generation, B-spline curves, properties, open uniform basis functions, non-uniform basis functions, periodic b-spline curve and NURBS. Implicit and explicit function of surfaces, types of surfaces, Surface Representation, Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces, Hermite Bi-cubic surface, Bézier Surface, Coons Surface	09
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 Surface and Solid Model:** Solid Modeling for Part, Assembly: Bottom-up and Top-down assembly	04

Unit No.	Topics	Teaching Hours
	approaches, Interference Detection, Finite Element Analysis, Computer Aided Part Programming, Computer Aided Process Planning, Automated Layout and Drafting, Computer Aided Manufacturing. Product Lifecycle Management.	
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 static structural problems, properties of stiffness matrix. 1-D structural problems with elimination and penalty approaches. Trusses: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members. Case Studies on static structural problem.	16
	Total	**42**

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. Develop awareness of computer skills for product development cycle.
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.