GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3161903
Semester –VI
Subject Name: Computer Aided Design

Type of Course: Elective

Prerequisite: Nil

Rationale:
Computers have become inevitable in today era and find their application in various stages of product development. This course intends to introduce students to use of computers in the phases of product design viz. conceptualization, geometric modeling, graphical representation and finite element analysis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hours
1	**Introduction:** A typical product cycle, CAD tools for the design process of product cycle, CAD / CAM system evaluation criteria, Input / Output devices; Graphics Displays: Refresh display, DVST, Raster display, pixel value and lookup table, estimation of graphical memory, LCD, LED fundamentals. Concept of Coordinate Systems: Working Coordinate System, Model Coordinate System, Screen Coordinate System. Line and Curve generation algorithm: DDA, Bresenham's algorithms. Graphics exchange standards and Database management systems.	05
2	**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. Various types of surfaces along with their typical applications.	07
3	**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

4	**Geometric Transformations:** Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D; Orthographic and perspective projections. Window to View-port transformation.	05
5	**Finite Element Analysis:** 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 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.	18
6	**Engineering optimization:** Introduction to optimization techniques design of Machine Elements, Johnson's method.	04

Suggested Specification table with %Marks (Theory):

Distribution of Theory Marks%					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	20	25	25	10	10

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Course Outcomes: Students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Demonstrate basic concept of computer aided design and its applications.	20
CO-2	Make use of various concepts and characteristics in geometric modeling.	20
CO-3	Analyze geometric transformations.	25
CO-4	Determine stress and strain in structural elements through FEA.	25
CO-5	Summarized optimization techniques for design of machine elements.	10

Reference Books:

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.
5. David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", McGraw-Hill.
6. S.S.Rao, "Engineering Optimization", A wiley –Interscience.

List of Experiments:

1. Prepare a programme for plotting lines and curves using algorithms learned.
2. Introductory exercise for 3-D modelling.
3. Exercise for advanced 3-D modelling.
4. Exercise for 3-D editing options.
5. Exercise for Assembly modelling.
6. Exercise for FEA of 1-D structural problems.
7. Exercise for FEA of trusses.
8. Exercise for FEA using Beam Element.
9. Exercise for FEA of 1-D thermal problems.
10. Exercise for FEA of 2-D structural problems.
11. Exercise for developing the optimization model of machine element using Johnson Method.

Major Equipment:

1. Computers / Workstations
2. CAD Software
3. FEA Software

List of Open Source Software/learning website:

1. www.nptel.ac.in/
2. http://help.autodesk.com/view/fusion360/ENU/.
   https://academy.autodesk.com/course/108871/introduction-cad-engineers
3. http://help.autodesk.com/view/fusion360/ENU/?learn=assemble
4. http://help.autodesk.com/view/fusion360/ENU/?learn=simulate
5. https://academy.autodesk.com/curriculum/introduction-cad-and-cae
6. https://www.youtube.com/watch?v=XmBNKNIz0rY
7. https://www.youtube.com/watch?v=DmWHKkBnw6o