GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering (CAD/CAM)

Subject Code : DI04065041

Subject Name : Computer Aided Design

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Professional Elective - II

Prerequisite:	NIL
Rationale:	This CAD course is essential for mechanical engineers, especially those in CAD/CAM, as it provides a solid foundation in computer-aided design. Students will learn the history, core concepts, and practical applications of CAD, gaining insight into its importance in modern engineering. Key topics include coordinate systems, line and curve generation algorithms, and geometric transformations—fundamental tools for creating accurate designs. The course also covers graphic standards and CAD/CAM data exchange formats to support smooth communication across design platforms. Students will explore curve-representation methods, surface types, and solid modeling techniques, including feature-based modeling, enabling them to build detailed and complex models. An introduction to Finite Element Analysis (FEA) further prepares them to analyze and solve engineering problems. Overall, this course equips students with essential modern design skills and tools, preparing them for successful engineering careers.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
CO1	Demonstrate an understanding of the core principles and tools of Computer-Aided Design.
CO2	Apply graphic standards, data exchange formats, and geometric transformations in developing engineering models.
CO3	Use parametric curve and surface representations to create efficient and accurate CAD models.
CO4	Analyze and compare various CAD modeling techniques.
CO5	Apply basic 1-D Finite Element Analysis and use FEA software to analyze simple engineering problems.

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	20	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Introduction** 1.1 History, basic concepts, definitions, and applications of CAD. 1.2 Need for CAD, key features, benefits, and functional areas. 1.3 Design steps in a CAD system and reasons for its implementation. 1.4 Common CAD software and their main features. 1.5 Coordinate systems: Working, Model, and Screen.	7	18
2	**CAD Standards and Geometric Transformations** 2.1 Graphic standards: need, types, features, system requirements, and applications; introduction to GUI—concept, meaning, and features. 2.2 CAD/CAM data exchange: need, methods, format types, IGES structure, and STEP implementation. 2.3 2D Geometric Transformations: translation, scaling, rotation, reflection, shearing, homogeneous coordinates, and composite transformations with examples. 2.4 3D Geometric Transformations: translation, rotation, scaling, and reflection (theory only).	12	26
3	**Lines, Curves and Surfaces** 3.1 Line and curve generation algorithms: DDA and Bresenham for lines (with examples), Bresenham for circles (no example). 3.2 Parametric, analytic (Line, circle, parabola, hyperbola, ellipse), and synthetic curves (Cubic Spline, Bezier Curve, B-Splines): concepts, continuity, advantages, properties, and	12	26

	applications (only theory). 3.3 Parametric representation of surfaces: analytical (plane, ruled, edge, revolution, tabulated) and synthetic (Bezier, B-spline) (only theory).		
4	**Representation of solids** 4.1 Concept and relation between Geometry and Topology. 4.2 Comparison of wireframe, surface, and solid models, including solid model properties. 4.3 Solid model representation schemes: B-rep, CSG, sweep, primitive instancing, and cell decomposition. 4.4 Feature based modelling.	**7**	**18**
5	**Finite Element Analysis** 5.1 Basic procedure for solving problems using Finite Element Analysis (FEA). 5.2 1-D FEA: shape functions, natural coordinates (theory), strain–displacement matrix, stiffness matrix derivation (elimination approach and penalty approach), and its properties. 5.3 1-D thermal problems (Introductory level). 5.4 FEA software, element types, boundary conditions, and basic steps for problem-solving using FEA packages.	**7**	**12**
	Total	**45**	**100 %**

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication
i.	CAD / CAM: Theory and Practice	Ibrahim Zied	Tata Mcgraw- Hill.
ii.	CAD / CAM and Automation	Farazdak Haideri	Nirali Prakashan
iii.	CAD/CAM: Principles and Applications	P N Rao	McGraw Hill Education
iv.	Computer Graphics	Hearn E J and Baker M P	Pearson
v.	Introduction to Finite Elements in Engineering	Chandrupatla T A	PHI

vi.	Finite Element Analysis	S. S. Bhavikatti	New Age Publishers

(b) Open source software and website:

1. https://nptel.ac.in/courses/112102101
2. https://www.youtube.com/watch?v=A3i2qFx7d5g
3. https://youtu.be/z5CuHzUPnYY?si=DhrYst6ZTWcRGIlT
4. https://youtu.be/z0sNZiYq6tI?si=t8U1h9YLcfboJExR
5. https://www.youtube.com/playlist?list=PLuAADu3OvBt5OXDZzk9Lq57dAzR_nC3mH
6. https://www.youtube.com/playlist?list=PLYwpaL_SFmcAtxMe7ahYC4ZYjQHun_b-T
7. https://www.tutorialspoint.com/computer_graphics/line_generation_algorithm.htm
8. https://www.tutorialspoint.com/computer_graphics/circle_generation_algorithm.htm
9. https://www.youtube.com/playlist?list=PLrOpxdi4yBrFO-wajK1-9S5qK3dVKQ4hZ

Suggested Course Practical List:

Sr,	Unit	Practical Exercises	Hrs
01	**I**	Preparatory Activity • Suggest CAD system configuration. • List out various CAD software and compare their silent features.	**02**
02	**III**	Practical Exercise on Line Generation and Problem Solving Using DDA and Bresenham Algorithms.	**04**
03	**IV**	Prepare a simple model in CAD software using surface and solid model and compare its various properties.	**02**
04	**-**	Introduction to Octave /Scilab or any similar software for various matrix operations and data plot.	**04**
05	**II**	Solve 2D geometric transformation problems using Octave/Scilab or any similar software and plot the resulting shapes.	**04**
06	**V**	Solve 1-D problems (mechanical element with thermal system) with the help of elimination approach and penalty approach using Octave/ Scilab or any similar software.	**06**
07	**V**	Introduction to Finite Element Analysis software.	**02**
08	**V**	Design a simple mechanical element (e.g., shaft, lever) and create a 3D model of it. Validate the traditional design using FEA software and compare the results.	**06**
Total			**30**

List of Laboratory/Learning Resources Required:

Sr.No.	Equipment Name with Broad Specifications	Pr. No.
1	Computer system with latest configuration.	All
2	GNU Octave / Scilab or similar software	2,3,4,5
3	FEA software	6,7

Suggested Project List:

1) Take a real life component; prepare its 3-D model with proper dimensions. Identify the boundary condition and do FEA of the same.
2) Prepare presentation of Graphics standard which has not been included in the syllabus.
3) Write DDA and Bresenham's algorithms for Line and Circle in to Octave/ Scilab or similar software.
4) Solve 2-D geometric transformation in Open office/Excel.
5) Compare difference in result by changing mash element type by keeping other parameters and boundary conditions same.

Suggested Activities for Students:

Sr. No.	Activity
i.	Create a timeline of CAD development, explore popular CAD software, and compare their features, applications, and industry usage.
ii.	Analyze and present case studies showing CAD implementation in automotive, aerospace, architecture, and manufacturing, highlighting functional areas like design and simulation.
iii.	Implement DDA and Bresenham's algorithms in a programming environment to visualize line generation and compare efficiency.
iv.	Develop posters or info graphics on CAD graphic standards, and explore 2D transformations (translation, rotation, scaling) through interactive simulations.
v	Investigate and present the use of parametric curves and surfaces, including Bezier and B-splines, and experiment with feature-based modeling for parametric designs.
vi	Solve engineering problems using FEA software, analyze stress distributions, and present findings with discussion on element types and methods.

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