

Course Code:	49050102
Course Name:	Computer Aided Design & Analysis
Category of Course:	Core
Prerequisite Course:	UG level course in CAD

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
3	0	2	4	40

Course Objectives	
1	To impart the parametric fundamentals to create and manipulate geometric models.
2	To provide exposure of modelling techniques for curves, surfaces and solids
3	To operate CAD software for feature-based modelling, mass property calculations and assembly modelling
4	To learn about CAD data formats and exchange standards

Syllabus			
Unit No.	Topic	Prerequisite Topic	Teaching Hours
01	Introduction to CAD	---	04 (10%)
	Conventional and Computer Aided Design Processes		
	Product Life Cycle and Role of CAD		
	Applications of CAD		
	Configuration of a graphic system Functions of a graphics package		
02	CAD Hardware and Software	---	04 (10%)
	Types of systems & Evaluation criteria		
	Input devices, Output devices, Display devices		
	Technical Specification of CAD Workstation		
	Computer Software-Operating System Application software in CAD		
03	Principles of Computer Graphics	---	04 (10%)
	Introduction to Computer Graphics		
	Graphic primitives		
	Scan Conversions		
	Plotting of Analytical Curves		
	DDA and Bresenham's Algorithm for generation of various figure 2D & 3D Transformation		
04	Curves	---	04 (10%)
	Introduction to Curves		
	Continuity conditions & Mathematical representation of plane & space curves		
	Conics, Spline, Hermite Curves		
	Bezier Curves B-Spline Curves		
05	Surfaces	---	04 (10%)
	Introduction to Surface Generation and description		
	Implicit and Explicit function of surfaces		
	Types of surfaces, Surface representation, Analytic & Parametric surfaces		
	Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces Hermite Bi-Cubic surface, Bezier Surface, Coons Surface		
06	Solids	---	04 (10%)
	Introduction Solid Representation		
	Analytical Solid modeling		
	Regularized Boolean set operations		
	Boundary representations (B-Rep)		
	Constructive Solid Geometry (CSG) Comparison of representations		
07	CAD Database	---	04 (10%)
	Standards in CAD, Graphics and Computing standards		
	Data Exchange Standards & Design database		
	Evaluation of data exchange format IGES & STEP representations		
08	Feature Based Modelling	---	04 (10%)
	Features and primitives		
	Feature entities 2D sketching, 3D sketching		

	Feature representation, Creating features		
	Parametric, Relations and constraints		
	Feature manipulations		
09	Geometric and Mass Properties		04 (10%)
	Geometric Properties	---	
	Calculate length of contours and curves		
	Calculate areas, Calculate centroids		
	Calculate inertia properties		
	Mass properties		
	Properties evaluation		
10	Assembly Modelling		04 (10%)
	Differences between part and assembly modelling		
	Mating conditions & Type of joints		
	Bottom-up Assembly Modelling approach		
	Top-down Assembly Modelling approach	---	
	WCS and Mate Methods to assemble parts		
	Managing assemblies, Working with subassemblies		
	Assembly motion studies		

Course Outcome	
1	Students will understand fundamentals of computer graphics and geometrical modelling
2	Students will be able to select input and output devices for computer systems for mechanical engineering requirements.
3	Students will be able to apply knowledge of mathematical concept for geometry manipulation and modeling of curves, surface and solids.
4	Students will be able to operate CAD packages to prepare solid model of components, assemble them to represent complex mechanical systems.
5	Students will be able to develop computer algorithm for design and analysis of mechanical systems.
6	Students will learn estimation of mass properties of model along with feature-based modelling.
Suggested Reference Books	
1	Mastering CAD / CAM Ibrahim Zeid McGraw-Hill
2	Geometric Modelling M Mortenson Industrial Press
3	CAD / CAM: Theory and Practice Ibrahim Zeid McGraw-Hill
4	Mathematical Elements of Computer Graphics David F Roger McGraw Hill
5	Computer Graphics: C Version Hearn and Baker Prentice Hall of India
6	Curves and Surfaces for CAGD: A Practical Guide 5/e, Gerald Farin Morgan Kaufmann
7	Computer Graphics and Geometric Modelling David Salomon Springer
8	Computer Aided Engineering Design Anupam Saxena and Birendra Sahay Springer
9	Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development D E Whitney Oxford Press
10	An Introduction to AutoCAD for Beginners, Autodesk Press, San Rafael, California, USA.
11	Autodesk Fusion 360: A Tutorial Approach, 2nd Edition, CAD/CIM Technologies, Prof. Sham Tickoo, Purdue University Northwest, USA

Proposed Evaluation Scheme by Academicians (Percentage of Weightage out of 100%)					
Theory Descriptive Test	<input type="text"/>	MCQ Test	<input type="text"/>	Hands on Project	<input type="text"/>
Formulas and Derivation Test	<input type="text"/>	Numerical Test	<input type="text"/>	Seminar	<input type="text"/>

Practical Project/Hands on Project		
Sr. No.	List of Practical Projects	Linked with Unit
1	Introduction to CAD Tools and Hardware	Unit 1,2
2	Sketching/Drafting of assigned problem using programming	Unit 8
3	Modeling of assigned problem	Unit 8
4	Modeling using parametric relations	Unit 8
5	Modeling using linkage options	Unit 8
6	Practice for assembly creation	Unit 10
7	Practice for view generation	Unit 10
8	CAD Format Conversion	Unit 7
9	Geometric Properties - surface and mass properties	Unit 9
10	Programming Exercises for DDA / Bresenham / Transformations	Unit 3-6

List of Recommended MOOC Courses:

- 1) <https://www.coursera.org/specializations/cad-design-digital-manufacturing>
- 2) <https://www.coursera.org/learn/engineering-design-process-fusion-360>
- 3) <https://www.coursera.org/learn/3d-model-creation-fusion-360>
- 4) <https://nptel.ac.in/courses/112/102/112102101/>
- 5) <https://nptel.ac.in/courses/112/104/112104031/>
- 6) https://onlinecourses.swayam2.ac.in/nou20_cs15/preview

List of Recommended Certifications:

- 1) <https://www.autodesk.com/certification/learn/course/fusion360-intro-modeling-design-professional>
- 2) <https://www.autodesk.com/certification/learning-pathways/cad-mechanical-design>