COURSE TITLE	**COMPUTER AIDED DESIGN**
COURSE CODE	**01ME1506**
COURSE CREDITS	**4**

Objective:

1 In the modern era of digital product development, the use of computers has become indispensable across all stages of design and manufacturing. This course introduces the foundational principles of Computer Aided Design (CAD), focusing on computer graphics, modeling techniques, and geometric transformations. It equips students with the knowledge of input/output devices, modeling algorithms, and data management required to create and analyze 2D and 3D models. Additionally, the course exposes students to recent advancements in CAD technologies, including cloud-based platforms and additive manufacturing applications, thereby preparing them for industry-relevant design and simulation tasks.

Course Outcomes: After completion of this course, student will be able to:

1 Apply fundamental algorithms such as DDA and Bresenham's to generate graphical entities and evaluate their efficiency in computer-aided design.

2 Construct parametric representations of curves and surfaces, and analyze their continuity properties for geometric modeling applications.

3 Compare solid modeling techniques and demonstrate Boolean operations to create complex 3D geometries.

4 Implement 2D/3D geometric transformations and validate their use in orthographic/perspective projections.

5 Utilize cloud-based CAD tools to collaborate on design projects, demonstrating version control and real-time editing features.

6 Model 3D geometries adhering to additive manufacturing constraints and prepare them for prototyping using slicing software.

Pre-requisite of course: Engineering Mathematics, C language

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact 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.	8
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.	10
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.	5
4	**Geometric Transformations:** Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D; Orthographic and perspective projections., Window to View-port transformation.	7
5	**Recent Trends in CAD** Introduction to cloud-based CAD platforms (e.g., Onshape, Autodesk Fusion 360), Collaboration and version control in CAD, Benefits of online CAD tools for design and simulation, Real-time collaboration features, Introduction to CAD in mobile applications.	6
6	**CAD for Additive Manufacturing** Basics of Additive Manufacturing and its CAD requirements, Design considerations for 3D printing (support structures, overhangs, slicing), File formats for 3D printing (STL, OBJ), Introduction to slicing software and simulation, Parametric modeling for rapid prototyping.	6
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Develop the DDA Line drawing algorithm using C language.** Develop the DDA Line drawing algorithm using C language.	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
2	**Develop the Bresenham's Line drawing algorithm using C language.** Develop the Bresenham's Line drawing algorithm using C language.	2
3	**Generate 2D Technical Drawing from 3D Model** Generate 2D Technical Drawing from 3D Model	2
4	**Advanced Drafting Techniques Using Layers and Annotations** Advanced Drafting Techniques Using Layers and Annotations	2
5	**Introductory exercise for 3-D modelling and editing options.** Introductory exercise for 3-D modelling and editing options.	2
6	**Generate a 3D model using extrude, revolve, sweep, and loft operations.** Generate a 3D model using extrude, revolve, sweep, and loft operations.	2
7	**Generating and Manipulating Patterns in CAD Modeling** Generating and Manipulating Patterns in CAD Modeling	2
8	**Model and analyze a surface geometry using surface modeling tools. Exercise for Assembly modelling.** Model and analyze a surface geometry using surface modeling tools. Exercise for Assembly modelling.	2
9	**Assemble multiple components and apply mechanical mates or constraints.** Assemble multiple components and apply mechanical mates or constraints.	2
10	**Sheet metal design using CAD software.** Sheet metal design using CAD software.	2
11	**Collaborate on CAD modeling using a cloud-based platform like Onshape.** Collaborate on CAD modeling using a cloud-based platform like Onshape.	2
12	**Generate a part suitable for 3D printing and export it in STL format.** Generate a part suitable for 3D printing and export it in STL format.	2
Total Hours		**24**

Textbook :

1 CAD / CAM: Theory and Practice, Ibrahim Zied, McGraw-Hill, 1991

2 Computer Graphics, Hearn E J and Baker M P, Pearson, 1986

References:

1 Computer Graphics, Computer Graphics, Sinha & Udai, McGraw-Hill Education, 2007

2 Computer Aided Design and Manufacturing, Computer Aided Design and Manufacturing, M.P. Groover and E.W. Zimmers Jr., Pearson Education (India), 2003

References:

3 CAD/CAM: Principles and Applications, CAD/CAM: Principles and Applications, P.N. Rao, McGraw Hill Education, 2010

4 Mathematical Elements for Computer Graphics, Mathematical Elements for Computer Graphics, David F. Rogers and J. Alan Adams, McGraw-Hill, 1989

5 CADCAM: Principles, Practice and Manufacturing Management, CADCAM: Principles, Practice and Manufacturing Management, Chris McMahon and Jimmie Browne, Addison-Wesley, 1998

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	45.00	35.00	20.00	0.00

Instructional Method:

1 Animation, Presentation

Supplementary Resources:

1 http://nptel.iitm.ac.in

2 Inkscape - Open Source vector graphics editor