Course Syllabus
Faculty of Technology
Semester-1

Subject: Computer Aided Design

Type of course: Major (Core)

Prerequisite: None

Rationale:

Computers have become inevitable in today's 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. the students of mechanical engineering programme are mainly involved in drafting, modeling, analysis, manufacturing, inspection and planning activities at industries. Hence for all such activities, reference document is the drawing of components/assemblies to be manufactured. In this context, it is a priority to prepare, read and interpret these drawings correctly for production of components and assemblies accurately and precisely.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
1	4	2	5	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	Write a code to plot various geometrical entities based on user input.	10
2	Write a code to read a model file in neutral formats and identify its features.	10
3	Write a code to read a model file in neutral formats and estimate its mass properties.	10
Total		30

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**Introduction:** Conventional and computer aided design processes, Product Life Cycle and Role of CAD, Applications of CAD.	2	5%
2	**Principles of Computer Graphics:** Introduction, graphic primitives, plotting of analytical Curves, coordinate systems, Half-Spaces and Homogeneous Coordinates, 2D (Translations, Rotation, Scaling and Shear) and 3D transformation (Translations, Rotation, Scaling, Shear, Orthographic and Perspective Projections), Windows to View port transformation, Clipping.	8	15%
3	**Curves:** Introduction to curves, parametric continuity condition, geometric continuity condition, Conics, Spline representation, Hermite Curves (Algebraic and Geometric Forms, Basis Functions, Matrix Form, Tangent Vectors, Truncating and Sub-dividing, 3-point and 4-point interpolation), Bézier Curves (Bézier basis functions, control points, truncating and subdividing, composite Bézier curve, characteristics of Bézier curve), B-Spline Curves (Uniform and Nonuniform B-Spline basis function, Quadratic and Cubic B-Spline basis function, Closed B-Spline Curve, Continuity, NURBS, Representation of conics with NURBS)	8	25%
4	**Surfaces:** Introduction, Implicit and explicit function of surfaces, types of surfaces, Surface Representation, Surface Analysis (Tangent, Normal, Twist, Distance Calculation, Curvature, Tangent Plane), Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces, Hermite Bi-cubic surface, Bézier Surface, Coons Surface,	6	20%
5	**Solids:** Introduction, Solid Representation, Properties of Solid model, Regularized Boolean set operations, Primitive instancing, Sweep representations, 05 10 Boundary representations (B-rep), Constructive Solid Geometry (CSG), Comparison of representations.	5	10%

6	**Feature Based Modelling:** Features and primitives, Feature entities, 3D sketching, Feature representation, Creating features, Parametrics, Relations and constraints, Feature manipulations **Geometric and Mass Properties:** Geometric Properties, Calculate length of contours and curves, Calculate areas, Calculate centroids, Calculate inertia properties, Mass Properties, Properties Evaluation. **Assembly Modelling:** Differences between part and assembly modelling, Mating conditions, Bottomup assembly modelling approach, Top-down assembly modelling approach, WCS and mate methods to assemble parts, Managing assemblies, Working with subassemblies, Assembly analysis	10	20%
7	**CAD Database:** Evaluation of data — exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF	3	5%

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (**Revised Bloom's Taxonomy**)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	10%	15%	15%	10%	10%	10%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Students will understand fundamentals of computer graphics and geometrical modelling.
CO2	Students will learn various techniques for surface and solid modelling.
CO3	Students will learn estimation of mass properties of model along with feature-based modelling.
CO4	Students will learn assembly modelling and CAD data exchange.

List of Tutorials:

Sr. No	Descriptions	Unit No	Hrs
1	Programming Exercises for Point, Line, and Circle Plotting	2	2
2	Programming Exercises for Curves	3	3
3	Programming Exercises for Transformations	2	4
4	Introduction to CAD Tools and Hardware	1	3
5	Exercise on Surface Modelling	4	4
6	Design for Solid Modelling.	5	4
7	Programming Exercises for estimating surface and mass properties of model.	6	5
8	Create on Assembly work	6	6

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

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 Pretice 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.