GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)/ MECHANICAL (MACHINE DESIGN) (09)

COMPUTER AIDED DESIGN

SUBJECT CODE: 2710802

M.E. 1st SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: The course is intended to provide exposure of modelling techniques for curves, surfaces and solids. It also includes topics on feature based modelling, mass property calculations and assembly modelling. Topic on CAD data formats and exchange standards is also included

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	4#	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Conventional and computer aided design processes, Product Life Cycle and Role of CAD, Applications of CAD.	02	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.	08	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 Non-uniform B-Spline basis function, Quadratic and Cubic B-Spline basis function, Closed B-Spline Curve, Continuity, NURBS, Representation of conics with NURBS)	08	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,	06	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.		
6	Advanced Topics: 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, Bottom-up 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	03	05

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.
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

List of Experiments:

Laboratory sessions should be conducted to include followings. Apart from conventional laboratory sessions, students should be given topics from syllabus for which they should compile literature and present the same.

1. Programming Exercises for Point, Line, and Circle Plotting
2. Programming Exercises for Curves
3. Programming Exercises for Transformations
4. Introduction to CAD Tools and Hardware
5. Surface Modelling
6. Solid Modelling
7. Programming Exercises for estimating surface and mass properties of model.
8. Assembly

Open Ended Problems:

1. Write a code to plot various geometrical entities based on user input.
2. Write a code to read a model file in neutral formats and identify its features.
3. Write a code to read a model file in neutral formats and estimate its mass properties.

Course Outcome:

After learning the course the students should be able to

1. Students will understand fundamentals of computer graphics and geometrical modelling.
2. Students will learn various techniques for surface and solid modelling.
3. Students will learn estimation of mass properties of model along with feature based modelling.
4. Students will learn assembly modelling and CAD data exchange.