Subject Name : Computer Graphics

Subject Code : CE 606-2 / IT 704-1

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
03	00	04	07	05	3	70	30	20	30	150

Learning Objectives:

- This course prepares students for activities involving the design, development, and testing of modeling, rendering, and animation solutions to a broad variety of problems found in entertainment, sciences, and engineering.
- Students will learn: (1) how to develop interactive programs that use effectively the graphics functionalities available in contemporary personal computers, (2) the fundamental principles and technologies upon which these functionalities, and possibly their future evolutions, are based, and (3) the skills for designing and implementing practical graphic solutions to challenging problems in different application domains.

Outline of the Course:

Sr. No	Title of the Unit	Minimum Hours
1	Introductory concepts	5
2	Graphics Output Primitives	10
3	2D Viewing	8
4	2D-3D Transformations	12
5	Advanced Topics	10

Total hours (Theory): 45

Total hours (Lab): 60

Total hours: 105

Detailed Syllabus

Sr. No	Topic	Lecture Hours	Weightage(%)
1	**Introductory concepts:** Introduction of Coordinate representation and Pixel Graphics output devices: CRT, Raster Scan & Random Scan systems; Color CRT monitors, DVST, flat-panel displays, video controller and raster scan display processor. Graphics Input Devices: Keyboard, Mouse, Track-ball, space ball, Joysticks, data Glove, Light Pen, Digitizer, Image scanners, touch panels, voice systems; Graphics software	5	10
2	**Graphics Output Primitives:** Point and Lines, Line Drawing Algorithms: Simple, DDA, Bresenham's Line Drawing algorithm, Circle and Ellipse drawing algorithm, Polygon drawing: Representation of polygon; Conventional methods for drawing polygons; Real time Scan Conversion and Run length encoding; Filled area primitives, character generation, Antialiasing	10	25
3	**2D Viewing:** Viewing pipeline, Window-to-viewport transformation, 2-D Clipping, Chen-Sutherland Line Clipping, Mid-point subdivision algorithm, Liang-Barsky clipping, Cyrus-Beck line clipping; Polygon Clipping: Sutherland-Hodgeman and Weiler-Atherton polygon clipping; Character Clipping	8	20
4	**2D-3D Transformations:** Scaling, Rotation, Translation, Shearing, Reflection; Homogeneous coordinates, Composite Transformations, Affine transformation; 3-D concepts and representation, Solid Body transformations, Projections: Perspective, Orthographic, Axonometric, Oblique projections	12	25
5	**Advanced Topics:** Curves and surfaces: Spline representations, Bezier curves and surfaces, B-spline curves and surfaces Visible surface detection methods: Back-face detection, depth-buffer, A-buffer, Z- buffer , scan-line Illumination models and surface rendering: Basic illumination models, Half-toning and dithering techniques, Polygon Rendering, Color models	10	20
	Total	**45**	**100**

Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

Learning Outcome:

1. Know and be able to discuss hardware system architecture for computer graphics. This includes, but is not limited to graphics pipeline, frame buffers, and graphic accelerators/co-processors.
2. Know and be able to design and implement model and viewing transformations, the graphics pipeline and an interactive render loop with a 3D graphics API.
3. Know and be able to use the underlying algorithms, mathematical concepts, supporting computer graphics. These include but are not limited to:
    - Composite 3D homogeneous matrices for translation, rotation, and scaling transformations.
    - Plane, surface normals, cross and dot products.
    - Hidden surface detection / removal.
    - Scene graphs, display lists.
4. Know and be able to select and use among models for lighting/shading.
5. Know and be able to use and select among current models for surfaces (e.g., geometric; polygonal; hierarchical; mesh; curves, splines).
6. Be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
7. Be able to discuss future trends in computer graphics and quickly learn future computer graphics concepts and APIs.

Reference Books:

1. Computer Graphics C Version, D. Hearn And P. Baker, Pearson Education
2. Computer Graphics, Foley and van Dam, Person Education
3. Computer Graphics with OpenGL, Hearn and Baker, Pearson
4. Procedural Methods for computer graphics, Rogers, TMH
5. Computer Graphics with virtual reality systems, R. K. Maurya, Wiley-India
6. Computer Graphics, Sinha & Udai, TMH

List of experiments:

Sr. No	Name of Experiment
1	Study of various C Graphics Function
2	Implementation and Using mouse in DOS
3	Implement DDA line algorithm
4	Implement Bresenham Line algorithm
5	Implement Bresenham Circle Algorithm
6	Implement Mid-point Ellipse algorithm
7	Implement Polygon Filling using Scan Fill, Flood Fill and Boundary Fill Algorithm
8	Implement algorithm of 2D Transformation of an Object
9	Implement Line Clipping using Cohen- Sutherland Algorithm
10	Implement Line Clipping using Liang-Barky algorithm
11	Implement Polygon Clipping using Sutherland-Hodgeman Algorithm
12	Implement Bezier Curve with C0, C1 continuity in OpenGL
13	Implement Illumination and shading apply on sphere using two light sources in OpenGL
14	Minor Project