

3/4 B.Tech. FIFTH SEMESTER

EM5T2

COMPUTER GRAPHICS

Credits: 3

Lecture: 3 periods/week
Tutorial: 1 period /week

Internal assessment : 30 marks
Semester end examination: 70 marks

Course Objectives

- Students should learn the basics of application programming interface (API) implementation based on graphics pipeline approach.
- Student should study and understand graphics through OpenGL.
- Students should learn the basic input devices and interaction of computer graphics.
- Student will have a thorough understanding of the fundamentals of 2D and 3D computer graphics.
- Understand the modern graphical hardware and rendering pipeline.
- Students should learn to use mathematical transformations and vector techniques in the production of computer graphics.
- Students should gain familiarity of clipping algorithms, rasterization techniques.

Learning Outcomes

Upon successful completion of the course, students will

- Develop and build an interactive graphics program using the OpenGL application programming interface.
- gain a proficiency with OpenGL to produce 2D and 3D computer graphics
- develop a facility with the relevant mathematics of computer graphics
- be able to write basic graphics application programs including animation
- demonstrate the application of mathematical transformations and vector techniques in producing graphics requiring rotation, translation, scaling, and 3D projection
- Create a polygonal mesh representing the boundary surface of a three dimensional object.
- have an good understanding of the clipping algorithms commonly used in computer graphics

UNIT I

Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable pipelines; Performance characteristics. Graphics Programming: The Sierpinski gasket; Programming two- dimensional applications.

UNIT II

The OpenGL: The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket; Plotting implicit functions.

UNIT III

Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; A simple CAD program;

Building interactive models; Animating interactive programs; Design of interactive programs; Logic operations.

UNIT IV

Geometric Objects and Transformations – 1 : Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling.

UNIT V

Geometric Objects and Transformations – 2 : Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices; Interfaces to three-dimensional applications; Quaternions.

UNIT VI

Viewing : Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL; Hidden-surface removal; Interactive mesh displays; Parallel-projection matrices; Perspective-projection matrices; Projections and shadows.

UNIT VII

Lighting and Shading: Light and matter; Light sources; The Phong lighting model; Computation of vectors; Polygonal shading; Approximation of a sphere by recursive subdivisions; Light sources in OpenGL; Specification of materials in OpenGL; Shading of the sphere model; Global illumination.

UNIT VIII

Implementation : Basic implementation strategies; The major tasks; Clipping; Line-segment clipping; Polygon clipping; Clipping of other primitives; Clipping in three dimensions; Rasterization; Bresenham's algorithm; Polygon rasterization; Hidden-surface removal; Antialiasing; Display considerations.

Learning resources

Text Books:

1. Edward Angel, "Interactive Computer Graphics A Top-Down Approach with OpenGL", Addison-Wesley, 5th Edition, 2008. (Chapters 1, 2, 3, 4, 5, 6, 7)
2. "Computer Graphics through OpenGL", Sumantha Guha, Chapman and Hall/CRC 2011.

Reference Books:

1. F.S. Hill, Jr, and M. Kelley, Jr. "Computer Graphics Using OpenGL", Pearson/PHI, 3rd Edition, 2009.
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, "Computer Graphics", Addison-wesley 1997.