UE18CS316: Computer Graphics and Visualization (4-0-0-4-4)

Computer Graphics is a sub field of Computer Science which studies methods for digitally synthesizing and manipulating visual content. CG deals with generating images using 3D modeling, shaders, ray tracing, computer animation. CG is responsible for displaying art and image data effectively and meaningfully to the consumer.

Course Objectives:

- Impart the basics of computer graphics, different graphics hardware systems and applications of computer graphics.
- Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis using openGL.
- Introduce the use of geometric transformations on graphics objects and their application in composite form and its implementation.
- Impart frame extraction with different clipping algorithms and transformation to a graphics display device.
- Introduce projections and visible surface detection techniques for display of 3D scene on 2D screen and rendering of projected objects to naturalize the scene in 2D view.

Course Outcomes:

At the end of this course, the student will be able to:

- Demonstrate the fundamentals of computer graphics and display pipeline systems.
- Be able to draw different 2D objects using scan conversion algorithms and also fill basic objects and perform their comparative analysis.
- Use geometric transformations on graphics 2D objects and demonstrate their application in composite form.
- Be able to extract a 2D object using clipping algorithms and apply transformations to a graphics display system. Implementation of all the algorithms using openGL.
- Apply graphics in greater depth to more complex courses like Image Processing, Virtual and Augmented Reality, etc.,

Pre-Requisite: UE18CS203- Data Structures.

Course Content:

Unit 1: 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. Graphics Programming: Programming Two Dimensional Applications. The OpenGL: The OpenGL API, Primitives and Attributes, Color, Viewing, Control Functions, Polygons.

12 Hours

Unit 2: Implementation

Basic Implementation Strategies, Four 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, Anti- Aliasing.

12 Hours

Unit 3: Geometric Objects and Transformations-I

Scalars, Points and Vectors, Three-Dimensional Primitives, Coordinate Systems and Frames, Modeling a Colored Cube, Overview of 2D Transformations: Rotation, Translation and Scaling, Affine transformations.

12 Hours

Unit 4: Geometric Objects and Transformations-II

Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGL Transformation Matrices, Interfaces to Three Dimensional Applications, Quaternion's.

12 Hours

Unit 5: Rendering, Viewing and Animation

Classical and Computer Viewing, Viewing with a Computer, Positioning of the Camera, Simple Projections, Projections in OpenGL. Light & Shades: Light & Matter, Light Sources, Global Illumination.Introduction to Rendering and Animation.

10 Hours

Tools / Languages : C/ C++/JAVA/Python using OpenGL.

Text Books:

1. "Interactive Computer Graphics - A top down approach wit WebGL",. Edward Angel and Dave Shreiner, Pearson Education , Indian Edition - Reg Office: Chennai, Seventh edition, 2016.
2. "OpenGL Programming Guide": Mason Woo, Jackie Neider, Tom Davis, Dave Shrenier: 3rd Edition, openGl version 1.2, Addision Wesley, 1999.

Reference Book:

1: "Interactive Computer Graphics: A Top-Down Approach with WebGL", Edward Angel, Pearson Education, 7th Edition,2015.