# COMPUTER GRAPHICS (ECS-308)

**Teacher Name:**

**Prof. N. Kohli**

**Course Structure**

| Type | L | T | P | Credits |
|---|---|---|---|---|
| PCC | 3 | 0 | 2 | 4 |

**Prerequisite:**

**Course Content:**

**Unit-1:**
Line generation: Points and Lines, Planes, Pixels and Frame buffers, vector and character generation. Graphics Primitives: Display devices, Primitive devices, Display File Structure, Display control text, Line-drawing Algorithms**:** DDA Algorithm Bresenham's line Algorithm, Circle-generating Algorithm**:** Midpoint Circle of Algorithm, Polygon Filling Algorithm.

**Unit-2:**
2-D Viewing and Clipping: Point Clipping, Line Clipping, Cohen-Sutherland Line Clippings, Cyrus-Beck Line Clipping Algorithm, Polygon Clipping: Sutherland Hodgman Algorithm, Polygon: Polygon Representation, Entering polygons, Filling polygons, Segments: Segments table, Creating deleting and renaming segments, Visibility.

**Unit-3 :**
2-D and 3-D Transformations: Basic Transformations: Translation, Rotation, Scaling, Shear, Composite Transformations: Rotations about a point, Reflection about a line, Homogeneous Coordinate Systems, 3-D Transformations, 3-D geometry primitives, Viewing Transformation, Projections: Parallel Projection, Orthographic & Oblique Projections, Perspective Projections. Interaction: Hardware input devices handling algorithms, Event handling echoing, Interactive techniques.

**Unit-4:**
Hidden Line and Surface: Back face removal algorithms, hidden line methods, Rendering and Illumination: Introduction to curve and Surfaces generation, Bezier, Hermite and B-spline algorithms and their comparisons.

**Unit-5:**
Multimedia and Animation: Basic of Animation, Types of Animation, Simulating, Accelerations, Computer Animation Tools, Multimedia Applications, Concepts of Hypertext/Hypermedia, Images, Audio and Video**,** Multimedia Tools.

**Text and Reference Books:**


1. Rogers, "Procedural Elements of Computer Graphics", McGraw Hill
2. Baker and Hearn, "Computer Graphics", PHI Publication.
3. Newman and Sproul, "Principle of Interactive Computer Graphics", McGraw Hill
4. Steven Harrington, "Computer Graphics", A Programming Approach, 2nd Edition

5. Rogar and Adams, "Mathematical Elements of Computer Graphics", McGraw Hill.

## Lab Work:

**Write Program in C or C++ for the following.**

1. Implementation of line generation using slope's method, DDA and Bresenham's algorithms.
2. Implementation of circle generation using Mid-point method and Bresenham's algorithm.
3. Implementation of ellipse generation using Mid-point method.
4. Implementation of polygon filling using Flood-fill, Boundary-fill and Scan-line algorithms.
5. Implementation of 2-D transformation: Translation, Scaling, Rotation, Mirror Reflection and Shearing (write a menu driven program).
6. Implementation of Line Clipping using Cohen-Sutherland algorithm and Bisection Method.
7. Implementation of Polygon Clipping using Sutherland-Hodgman algorithm.
8. Implementation of 3-D geometric transformations: Translation, Scaling and rotation.
9. Implementation of Curve generation using Interpolation methods.
10. Implementation of Curve generation using B-spline and Bezier curves.
11. Implementation of any one of Back face removal algorithms: Depth-Buffer algorithm, Painter's algorithm, Warnock's algorithm, Scan-line algorithm.

## Course Outcomes:

1. Understand and use various mathematical concepts and supporting composite 2-D & 3-D graphics transformations for hidden surface detection/ removal and various graphical algorithms. (Understand, Apply)
2. Design algorithms for various graphics shapes like ellipse, hyperbola, triangle etc. (Apply)
3. Use of various graphical tools and software in 3D Graphics API (e.g. OpenGL or DirectX). (Apply)
4. Understand and apply geometrical transformation and computer graphics in multidisciplinary field of engineering. (Apply)
5. Understand the hardware system architecture for computer graphics - graphics pipeline, frame buffers, and graphic accelerators/co-processors. (Understand)
6. Analyze and implement interactive graphics applications using programming language and graphics application programming interfaces. (Apply, Analyze)

## Lecture Plan

**Unit-I:**

**1.** Line generation: Points and Lines, Planes, Pixels and Frame buffers, vector and character generation. : **One Lecture**

**2.** Graphics Primitives: Display devices, Primitive devices, Display File Structure, Display control text: **Two Lectures**

3. Line-drawing Algorithms**:** DDA Algorithm Bresenham's line Algorithm, Circle-generating Algorithm**:** Midpoint Circle of Algorithm: **Four Lectures**

4. Polygon Filling Algorithm: **One Lecture**

**Unit-II:**

5. 2-D Viewing and Clipping: Point Clipping, Line Clipping, Cohen-Sutherland Line Clippings, Cyrus-Beck Line Clipping Algorithm, Polygan Clipping: Sutherland Hodgman Algorithm: **Three Lectures**.

6. Polygon: Polygon Representation, Entering polygons, Filling polygons, Segments: Segments table, Creating deleting and renaming segments, Visibility: **Four Lectures.**

**Unit-III**

7. 2-D and 3-D Transformations: Basic Transformations: Translation, Rotation, Scaling, Shear, Composite Transformations: Rotations about a point, Reflection about a line, Homogeneous Coordinate Systems: **Four Lectures**

8. 3-D Transformations, 3-D geometry primitives, Viewing Transformation, Projections: Parallel Projection, Orthographic & Oblique Projections, Perspective Projections. Interaction: Hardware input devices handling algorithms, Event handling echoing, Interactive techniques : **Four Lectures.**

**Unit-IV**

9. Hidden Line and Surface: Back face removal algorithms, hidden line methods: **Two Lectures.**

10. Rendering and Illumination: Introduction to curve and Surfaces generation, Bezier, Hermite and B-spline algorithms and their comparisons: **Three Lectures.**

**Unit-V**

11. Multimedia and Animation: Basic of Animation, Types of Animation, Simulating, Accelerations, Computer Animation Tools: **Three Lectures.**

12. Multimedia Applications, Concepts of Hypertext/Hypermedia, Images, Audio and Video**,** Multimedia Tools: **Four Lectures.**

**Five to Ten Lectures will be scheduled for tutorials and group discussions etc.**

**Text and References Books:**


6. Rogers, "Procedural Elements of Computer Graphics", McGraw Hill
7. Baker and Hearn, "Computer Graphics", Pearson Education.
8. Newman and Sproul, "Principle of Interactive Computer Graphics", McGraw Hill
9. Steven Harrington, "Computer Graphics", A Programming Approach, 2nd Edition
10. Rogar and Adams, "Mathematical Elements of Computer Graphics", McGraw Hill.


## Assignments

### Assignment 1

Q.1: Explain the followings:
a. Visibility
b. Segments: Segments table, creating, deleting and renaming segments.
Q.2: Explain Hardware input devices handling algorithms.
Q.3: Explain Event handling echoing.

### Assignment -2

**Q.1)** Write a short note on B-spline curve.
**Q.2)** What are the important properties of Bezier Curve?.
**Q.3)** List differences between parallel and perspective projection .
**Q.4)** Explain Back Face Removal algorithm for hidden surface removal?
**Q.5)** Describe orthographic and oblique projection.