

# Syllabus for CSE 167, Winter 2003

**Instructor: Dr. Farhana Bandukwala**

## 1. Introduction to basic raster graphics

Lecture 1: Intro to graphics

- a) Historical perspective
- b) Graphics vs Vision
- c) Applications of graphics
- d) Introduction to Open GL

Lecture 2: Concepts of raster graphics

- a) Raster vs vector: pixels vs strokes
- b) Advantages & Disadvantages:
- c) Algorithms
- d) Bit and pixel operations in OpenGL

Lecture 3: Graphics system

- a) Input and Output devices
- b) Random scan display processor
- c) Pipeline architecture
- d) Client Server model

**Assignment 1 handed out**

Lecture 4: User Interfaces

- a) Goals
- b) Styles
- c) Design considerations
- d) User Interface Management system

## 2. Geometry and Transformations

Lecture 5: 2D Geometrical Objects & transformations

- a) Geometrical Objects
- b) Operations
- c) Homogeneous coordinates and matrix representation of transformations

Lecture 6: Open GL objects and transformations

- a) Primitives in OpenGL
- b) World coordinate system
- c) Screen coordinate
- d) OpenGL transformation matrices

## 3. Curves

Lecture 7: Parametric Polynomials

- a) Explicit vs Implicit representation
- b) Linear approximations
- c) Parametric form
- d) Polynomial cubic curves

**Assignment 1 due beginning of class**

Lecture 8: Types of cubics

- e) Hermites, Beziars and BSplines

- f) Subdividing curves
- g) Drawing curves
- h) Curves in OpenGL

**Assignment 2 handed out**

4. Three dimensional rendering

Lecture 9: Three dimensional objects and transformations

- a) Geometrical objects
- b) Coordinate systems and transformations
- c) Matrix representation of 3D transformations
- d) Composite transformations

Lecture 10: Projections

- a) Perspective projections
- b) Parallel projection
- c) Camera position
- d) Clipping planes

Lecture 11: Surfaces

- a) Linear representations: Polygon meshes
- b) Parametric bicubic surfaces
- c) Subdivision Surfaces

Lecture 12: Rendering in Open GL

- a) View setup:
- b) Projections in Open GL
- c) Surfaces in Open GL

5. Illumination

Lecture 13: Light sources

- a) Achromatic
- b) Colored light
- c) Illumination models

**Assignment 2 due beginning of class**

Lecture 14: Surface shading

- a) Reflection models
- b) Computational issues
- c) Polygon shading

**Assignment 3 handed out**

Lecture 15: Illumination and Shading in OpenGL

- a) Specifying light sources
- b) Material properties
- c) Texture mapping
- d) Transparency

6. Hidden surface removal

Lecture 16: General concepts

- a) Functions of two variables and horizon line algorithm
- b) Techniques for efficient algorithms

Lecture 17: Image space algorithms

- a) Painter's algorithm
- b) Z Buffer algorithm

- c) A Buffer algorithm
- d) Z-buffers in Open GL

Lecture 18: Object space algorithms

- a) Depth sort algorithm
- b) BSP trees
- c) Octree-based algorithms

## 7. Object hierarchy

Lecture 19: General concepts and tree structures

- a) Uses for object hierarchy
- b) Trees and DAGs

**Assignment 3 due beginning of class**

Lecture 20: Scene graphs in OpenGL

- a) Geometry nodes
- b) Camera
- c) Lights and materials
- d) Transformations
- e) Display Lists

**Assignment 4 handed out**

## 8. Animation

Lecture 21: Basic concepts

- a) Animatable parameters
- b) Conventional vs computer-based

Lecture 22: Languages

- a) Linear list notations
- b) General purpose
- c) Graphical animation languages
- d) Controlling animation

Lecture 23: Animation tricks in Open GL

- a) Problems:
- b) General rules:
- c) Implementation in OpenGL
- d) Hardware-based animation: sprites

## 9. Graphics pipeline

Lecture 24: Standard graphics pipeline revisited

- a) Front end vs back end
- b) Performance barriers
- c) Multiprocessor architectures
- d) Unique architectures

## 10. Advanced topics

Lecture 25: Raytracing

Lecture 26: Radiosity

Lecture 27: Volume visualization

**Assignment 4 due beginning of class**