Computer Graphics
EG3101CT

Year: III **Total: 6 hours /week**
Part: I **Lecture: 3 hours/week**
Tutorial: 1 hour/week
Practical: … hours/week
Lab: 2 hours/week

Course description:
This course deals with graphics hardware, two dimensional and three-dimensional graphics, fundamentals of animation techniques; graphical user interface design, web graphics design and graphics design packages.

Course objectives:
After completion of this course students will be able to:
1. Acquire the knowledge of computer graphics.
2. Familiarize with hardware involved in graphics.
3. Familiarize with the algorithms to generate two-dimensional and three-dimensional graphical objects and animations.

Course Contents:

Theory

Unit 1. Introduction [3 Hrs.]
- 1.1. History of Computer Graphics
- 1.2. Application of Computer Graphics
- 1.3. CAD and CAM

Unit 2. Graphics Hardware [8 Hrs.]
- 2.1. Input Hardware
  - 2.1.1. Keyboard, Mouse (mechanical & optical), Light pen, Touch panel (Optical, Sonic, and Electrical), Digitizers (Electrical, Sonic, Resistive), Scanner, Joystick
- 2.2. Output Hardware
  - 2.2.1. Monitors
  - 2.2.2. Monochromatic CRT Monitors
  - 2.2.3. Color CRT Monitors
  - 2.2.4. Flat Panel Display Monitors
- 2.3. Hardcopy Devices
  - 2.3.1. Plotters
  - 2.3.2. Printers
- 2.4. Raster and Vector Display Architectures, Principles and Characteristics

Unit 3. Two Dimensional Algorithms and Transformations [10 Hrs.]
- 3.1. Mathematical Line Drawing Concept
- 3.2. Line Drawing Algorithms
  - 3.2.1. Digital Differential Analyzer (DDA)
  - 3.2.2. Bresenham's Line Drawing Algorithm
- 3.3. Mid-point Circle Drawing
- 3.4. Mid-point Ellipse Drawing Algorithm
- 3.5. Review of Matrix Operations – Addition and Multiplication
- 3.6. Two-dimensional Transformations
  - 3.6.1. Translation

3.6.2. Scaling
3.6.3. Rotation
3.6.4. Reflection
3.6.5. Shearing
3.7. Two-Dimensional Viewing Pipeline

Unit 4. Three-Dimensional Graphics [16 Hrs.]

4.1. Three-dimensions transformations
4.1.1. Translation
4.1.2. Scaling
4.1.3. Rotation
4.1.4. Reflection
4.1.5. Shearing
4.2. Three-dimensional Viewing Pipeline
4.3. Three-dimensions Projections
4.3.1. Concept of Projection
4.3.2. Projection of 3D Objects onto 2D Display Devices
4.3.3. Three-dimensional Projection Methods
4.3.3.1. Parallel Projection Method
4.3.3.2. Perspective Projection Method
4.4. Three-dimensional Object Representations
4.4.1. Polygon Surfaces
4.4.2. Polygon Tables
4.5. Introduction to Hidden Line and Hidden Surface Removal Techniques
4.5.1. Object Space Method
4.5.2. Image Space Method
4.6. Introduction to Illumination/ Lighting Models
4.6.1. Ambient Model
4.6.2. Diffuse Model
4.6.3. Specular Model
4.7. Introduction to Shading/ Surface Rendering Models
4.7.1. Constant Shading Model
4.7.2. Gouraud Shading Model
4.7.3. Phong Shading Model

Unit 5. Web Graphics Designs and Graphics DesignPackages [5 Hrs.]

5.1. Introduction to graphics file formats
5.2. Principles of web graphics design – browser safe colors, size, resolution, background, anti-aliasing
5.3. Type, purposes and features of graphics packages
5.4. Examples of graphics packages and libraries

Unit 6. Virtual Reality [3 Hrs.]

6.1. Introduction
6.2. Types of Virtual Reality
6.2.1. Non-immersive Virtual Reality
6.2.2. Semi-immersive Virtual Reality
6.2.3. Fully-immersive Virtual Reality
6.2.4. Augmented Virtual Reality
6.2.5. Collaborative Virtual Reality

6.3. Applications of Virtual Reality

Practical: **[30 Hrs.]**

As a part of the laboratory exercise, the students should implement all the algorithms studied in different chapters. At the end, students are required to integrate the codes they have written in earlier practical sessions to create a small project.

The lab contains few sessions dedicated to introduce the students to some of the popular professional graphics packages and CAD packages and explore their features. The course/lab instructor recommends packages to use.

Some algorithm implementation sessions may include:

1. Implementation of Digital Differential Analyzer (DDA), a line Drawing Algorithm.
2. Implementation of Bresenham's Line Drawing Algorithm.
3. Implementation of mid-point Circle Drawing Algorithm.
4. Implementation of mid -point Ellipse Drawing Algorithm.
5. Implementation of basic 2D transformation.
6. Implementation of basic 3D transformation.
7. Implementation of basic projections.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	3	6
2	Graphics Hardware	8	15
3	Two Dimensional Algorithms and Transformations	10	20
4	Three-Dimensional Graphics	16	25
5	Web Graphics Designs and Graphics Design Packages	5	8
6	Virtual Reality	3	6
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

References:

1. D. Hearn and M. P. Baker, "Computer Graphics", PHI Edition
2. T. I. James, D. Foley, A. Van Dam, S. K. Feiner, and J. F. Hughes, "Computer Graphics, Principles, and Practice", PHI Edition