Course Title: Computer Graphics

Course No: CSC-254 **Full Marks: 60+20+20**

Credit Hours: 3 **Pass Marks: 24+8+8**

Nature of course: Theory (3 Hrs.) + Case Study

Course Synopsis: This Graphics hardware, software, and applications, data structures for graphics, graphics languages, models for 2D and 3D objects, clipping, hidden surface elimination, depth buffer, raster graphics, shading rendering, splines tools.

Goal: The objective of this course is to understand the theoretical foundation of 2D and 3D graphics.

Course Contents:

Unit 1:

5 Hrs.

- **Introduction to Computer Graphics**

- Overview and Definition Computer Graphics.
- Relation Between Computer Graphics and Image Processing.
- Advantages of Computer Graphics.
- Areas of Applications and its Classification.

- **Graphics Hardware and Software**

- Overview and Development of Hardware and Software for Computer Graphics.
- Input and Output Technology.
- Hard Copy and Display Technologies, CRT, Raster-Scan Displays.
- Random Scan Display System.
- Raster-Scan System.
- Video Controller.
- Random Scan Display Processor.

- **Raster Graphics Algorithm**

- Meaning and Definition of Raster Graphics.
- Scan Conversion Algorithms of Line, Circle and Ellipse.
- Area Filling of Rectangle and Ellipse.
- Clipping of Lines, Circle and Ellipse.
- Clipping Polygons.

Unit 2:

10 Hrs.

- **Geometrical Transformations**

1. 2D Transformations:

- Translation, Rotation, Scaling, Reflection and Shearing.
- Homogeneous Coordinates and Matrix Representation of 2D Transformations.
- Composition of 2D Transformations.
- Window-to-Viewport Transformations.
- Efficiency.

2. 3D Transformations:

- Translation, Rotation, Scaling.
- Matrix Representation of 3D Transformations.
- Composition of 3D Transformations.

- **Viewing in 3D:**

- Projections, Specifying an Arbitrary 3D View.
- The Mathematics of Planar Geometric Projections and Its Implementation.

Unit 3:

15 Hrs.

- **3D Object Representation**

- Representing Curves and Surfaces.
- Overview of Polygon Surfaces, Polygon Tables, Plane Equations.
- Polygon Meshes.
- Parametric Cubic Curves (Spline Representations, Hermite Curve, Bezier Curve and Surfaces).
- Quadratic Surfaces (Sphere, Ellipsoid).

- **Solid Modeling**

- Sweep, Boundary and Spatial-Partitioning Representations.

Unit 4:

12 Hrs.

- **Visible-Surface Determination**
- Function of Two Variables.
- Techniques for Efficient Visible-Surface Algorithms.
- Algorithms for Visible-Surface Detection (Z-Buffer, List Priority, Scan Line Algorithms).

- **Illumination and Shading**

1. Overview of Illumination and Surface-Rendering Models:

- Basic Illumination Models (Ambient Light, Diffuse Reflection, Specular Reflection).

2. Overview of Shading and Polygon-Rendering Models:

- Constant Intensity Shading, Gouraud Shading, Phong Shading, Fast Phong Shading.

Unit 5:

3 Hrs.

- **Introduction to Virtual Reality and Animation**
- Introduction Virtual reality and animation.
- Overview, Importance and Key Terms of Virtual Reality and Animation.

Laboratory Works: All algorithms covered in the text to be implemented in PHIGS/OpenGL in C/C++.

Text / Reference Books:

- Foley, J. D., A. V. Dam, S. K. Feiner, J. F. Hughes, **Computer Graphics Principle and Practices**, Addison Wesley Longman, Singapore Pvt. Ltd., 1999.
- Hearn Donald, M. P. Baker, **Computer Graphics**, 2E, Prentice Hall of India Private Limited, New Delhi, 2000.

2CSc. 254 - Model Question

Tribhuvan University
Institute of Science and Technology

Bachelor Level/Second Year/Fourth Semester/Science — Full Marks: 60
Computer Science and Information Technology (CSc.254) — Pass Marks: 24
(Computer Graphics Model Question) — Time: 3 hours.

Candidates are required to give their answer in their words as far as possible.
All questions carry equal marks.

Attempt all the questions.

1. How line can be drawn in the computer graphics? Explain in detail about Bresenhems's line drawing algorithm.

2. What is a window to viewport transformation? Derive its transformation coefficient matrix.

3. Explain the following terms with practical applications.
   a) 3D Shear b) 2D Rotation

4. What do you mean by clipping? Explain in detail about line clipping algorithm.

5. Why filling algorithm is required? Explain about scan-line polygon fill algorithm.

6. How computer animation can be generated? Explain with reference to the polygon table.

7. How curves can be generated? Explain about Bezier curve.

8. How hidden-surfaces can be removed? Explain in detail about plane equation method.
   OR
   What happens if the hidden surface is not removed in the computer graphics? Explain in detail about depth buffer method.

9. What do you mean by intensity assignment? Consider 512 pixels X 512 scan lines image with 24-bit true color. If 5 minutes video is required to capture, calculate the total memory required?

10. Explain the importance of shading in the computer graphics. Explain in detail about Gouraud shading.
    OR
    Why shading model is required in the computer graphics? Explain in detail about Phong shading model.