MODULE: COMPUTER GRAPHICS

Aims and Objectives

- To provide students with the necessary theoretical an applications framework for computing science through the understanding of a broad range of interrelated disciplines;
- The ability to interact with the system by moving viewpoint or manipulating objects, with the results of these interactions being smoothly and convincingly transferred to the screen in real time;
- Investigate means of modelling objects using techniques which provide more efficient representations and their integration into the rendering pipeline in order to provide rapid real time visualisation of these objects;
- Investigate sophisticated lighting models for use in the rendering stage in order to produce more visually realistic output;
- The ability to render objects and environments in such a way that the results are as close as possible to photographs of equivalent real world objects and environments.

Assessment Methods:

- Written Exam 70%
- Course Work 30%

Reading List :

Title	Author	Publisher
OpenGL Programming Guide	Open Architecture Review Board (ARB)	Addison Wesley
OpenGL Reference Manual	Open Architecture Review Board (ARB)	Addison Wesley
Radiosity and Global Illumination	Francois Sillion and Claude Puech	
An Introduction to Ray Tracing	Andrew Glassner	
Radiosity and Realistic Image Synthesis	Michael Cohen and John Wallace	
Advanced Animation and Rendering Technqiues	Alan Watt and Mark Watt	
Geometric and Solid Modelling	Chistoph Hoffman	

Journals

Students will be expected to read selected articles from the following list of Journals and Conferences:

- Computer Graphics
- *The Visual Computer*
- *IEEE Computer Graphics and Applications*
- *ACM Transactions on Computer Graphics*
- *Communications of the ACM*
- SIGGRAPH
- EUROGRAPHICS
- European rendering workshop

Computer Graphics

1. Introduction

- Overview of Graphics

2. Graphics Display Technology

- Vector and raster graphics
- CRT displays: colour, double buffered displays, display characteristics
- Broadcast standards
- Display memory
- Raster system architecture.

3. Linear Algebra

- Basis
- Coordinate systems
- Vectors: vector operations (normalization, dot product, cross product).

4. Graphics Pipeline and Geometry

- Polygons
- Faces
- Edges
- Vertices
- Normals
- Curved surfaces
- Graphics pipeline.

5. Viewing Systems

- Cameras
- Pinhole camera model
- Viewing frustum
- Clipping
- Projections: viewport, aspect ratio
- Object space: world and camera.

6. Introduction to OpenGL

- Overview of OpenG: features, libraries, conventions, primitives
- Programming with GLUT.

7. Viewing Systems in OpenGL

- How to implement theory discussed in viewing systems lecture using OpenGL.

8. Transformations

- Transformations
- Representation
- Translation
- Rotation: derivation of the rotation matrix
- Scaling
- Affine transformations
- Local coordinate marker.

9. Hierarchical Transformations

- Pushing and popping matrices
- Hierarchies: sample programming a simple hierarchical chain model, multiple branched models.

10. Hidden Surface Removal

- Back-face culling
- The Painters algorithm
- Z-buffer algorithm
- Binary space partitioning trees.

11. Raster Methods

- Raster graphics overview
- Pixel coordinates
- DDA algorithm
- Midpoint line algorithm
- Midpoint circle algorithm.

12. Lighting and Shading

- Rendering overview
- Light sources
- Inverse square law, Cosine rule
- Lambertian illumination model
- Gouraud shading
- Phong shading
- Phong illumination model
- Materials and shading in OpenGL.

13. Texturing and Modeling

- 2D texture mapping
- Texture mapping in OpenGL
- content creation
- Modelling and texturing an object for display.

14. Particle Systems

- Fundamental principles, forces, collision detection.