Liverpool John Moores University

Title:	ADVANCED COMPUTER GRAPHICS
Status:	Definitive
Code:	**6014BECK** (118393)
Version Start Date:	01-08-2016
Owning School/Faculty:	Applied Mathematics
Teaching School/Faculty:	Beckett College London

Team	Leader
Paul Strickland	Y

Academic Level:	FHEQ6	**Credit Value:**	24	**Total Delivered Hours:**	72
Total Learning Hours:	240	**Private Study:**	168		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	24
Tutorial	24
Workshop	24

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	AS1	Report on mathematics and physics concepts.	30	
Essay	AS2	Report on state-of-the-art computer graphics technology as used in computer games.	20	
Artefacts	AS3	Implementation of a complex 3D graphics application.	50	

Aims

To provide additional mathematical and physics knowledge essential in complex 3D graphics and game software.

To explain the state-of-the-art computer graphics and optimization processes.
To develop skills in advanced computer graphics operations using modern graphical API.
To develop specific programming skills related to computer graphics.

Learning Outcomes

After completing the module the student should be able to:

1	Critically evaluate the mathematical concepts behind rigid body movements in 3D space.
2	Solve complex problems in 3D graphics and game using appropriate the mathematical and physics concepts.
3	Critically evaluate the state-of-art graphics processes employed in modern games development.
4	Critically evaluate the graphics rendering pipeline architecture and the way it affects GPU optimization.
5	Demonstrate sound knowledge of hardware transformations, lighting, multi-texturing, 3D collision detection and collision reaction.
6	Demonstrate ability to utilize High Level Shader Technologies.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Maths and physics	1	2
Computer graphics	3	4
3D graphics application	5	6

Outline Syllabus

Rigid body movements in 3D space.
Euler Angle
Numerical Calculus including Runge Kutta method
Complex Numbers and Quaternions
Eigenvalues and Eigenvectors
Revision of the Graphics Rendering Pipeline.
Application of Maths to Transformations
3D scene organization techniques
Optimizing graphical scene
Types of Geometric representation
Curves: Bezier, Catmull-Rom.
How to implement sub-systems (Collision/Animation) etc. with our Geometry.
Advanced Data Representation
Bounding Volumes (AABB, OBB, Capsules, Spheres) and how these work in Scenes.
Collision Detection (Broad/Narrow Phase Collisions, Picking, Ray-Casting)
Collision Response (Using Normals and Tangents, etc.).

Multi-Texturing and Blending
Rendering to a Texture
3D Animation Techniques – Key-Frame, Skeletal, Morph-Target (Per Vertex), LERP and SLERP.
Illumination, Local Illumination vs. Global Illumination, Faking Global Illumination
Revision of the Programmable Pipeline and the new generation of programmable pipeline techniques
The future of real-time graphics rendering

Learning Activities

Lectures incorporating demonstrations will be followed by tutor-led practical sessions. These will be supported by practical work in the laboratory.

Notes

This module teaches students advanced computer graphics techniques and the relevant mathematical concepts such as numerical calculus, complex numbers and quaternions. The module will use a modern graphics API such as OpenGL or DirectX to demonstrate how complex scenery can be constructed using a wide range of advanced graphics techniques.