Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS credits	Module Code	**Module Title**
		5	CMPU4030	Games Engines 1

8.9.1. Games Engines 1

Module author: Dr Bryan Duggan

Module Description:

The purpose of this module is to introduce students to the core concepts required to program 3D game engines. This course combines a foundation in maths and physics programming for 3D games, 3D graphics and artificial intelligence for games. This course has a technical focus and gives students the opportunity to learn practical 3D games development from the ground up. This course explores analytical geometry, linear algebra, matrices, Newtonian physics and quaternions and applies these techniques to problems in game engine programming using standard API's such as DirectX and OpenGL.

Module aim

The aim of this module is for students to learn the fundamentals of 3D game engine programming.

Learning Outcomes:

- Demonstrate an understanding of trends and advances in computer game technology.
- Solve common problems in computer games such as entity position, orientation and movement by using a variety of mathematical tools.
- Program a scene in 3D using standard API's.
- Represent and program a flexible camera suitable for a variety of game types (FPS and RTS).
- Make use of a physics engine to perform physics integration
- Make use of an audio engine to perform functionality such as 3D positional audio and occlusion
- Apply software design patterns to computer games engines
- Use UML and object oriented design to model computer games engines.
- Critically analyse how the techniques learned on the course are used in commercial games.

Learning and Teaching Methods:

Class time is split into a series of interactive "studio classroom" based lectures and practical problem solving in labs. In lectures, students have access to a PC, with appropriate software and development kits, so that material and examples can be examined in a live environment. In addition, students will be expected to proactively and independently seek out resources on the internet and from the library to supplement their own learning.

A Virtual Learning Environment (VLE) will be employed to distribute all teaching materials and to support student interaction with both other students and academic staff. Where new material is not presented in lectures, such material will be made available through the VLE and students are expected to proactively use this resource.

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Module content:

Mathematics for games

Vectors, trigonometry, matrices, translations, rotations, scaling, linear algebra, equations of lines, rays and planes, intersections of lines rays and planes

3D graphics

Introduction to the game loop, mathematics programming, the rendering pipeline, vertex buffers, texturing, meshes, particle systems, camera models.

Physics Simulation

Newtonian physics (force, acceleration, velocity, position, mass). Friction. Hamiltonian mechanics (quaternions, torque, angular velocity and acceleration, equations of motion and rotation.

Game Engines

Asset management, design patterns, programming a flexible camera, UML, object oriented game design.

Middleware

Physics - rigid bodies, joints, integration, collision detection. Audio – 3D positional audio, occlusion

Module Assessment

This module has a 50% weighting for the examination and a 50% weighting for the continuous assessment. Continuous assessment will consist of a single significant assignment, which may be individual or team based. Students will be expected to document and present their assignment work in the form of an ePortfolio or a blog. Students will be expected to enter their assignment into national and international competitions such as the XNA Ireland Challenge and the Imagine Cup. While it is important that students can demonstrate their technical ability through continuous assessment, it is equally important that they demonstrate both an understanding of the mathematical concepts and an appreciation for how the techniques learned on the course are used in commercial games. This will be assessed in the examination. Students will not be required to write code in the examination, but will be required to solve problems using the mathematics and physics concepts learned and to critically analyse examples of the techniques learned on the course in commercial games.

The suggested method of assessing the individual learning outcomes for the module is as follows:

Essential Reading:

Introduction to 3D Game Programming with DirectX 10, Frank D Luna, Jones & Bartlett Publishers; 1 edition (October 25, 2008)

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Game Physics Engine Development, Second Edition: How to Build a Robust Commercial-Grade Physics Engine for your Game, Ian Millington, Morgan Kaufmann; 2 edition (August 6, 2010)

Supplemental Reading:

Advanced Animation with DirectX (Focus on Game Development), Jim Adams , Course Technology PTR; 1 edition (May 22, 2003)

Web references, journals and other:

http://gamedevelopers.ie

http://gamesfleadh.ie

http://imaginecup.com

http://dreamspark.com

http://seriousgames.ie

Further Details:

4 hours per week for one semester

Date of Academic Council approval ……