City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester B in 2023/2024

Part I Course Overview

Course Title:	Topics in Computer Graphics
Course Code:	EE5808
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P5
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil Mathematical knowledge reaching the equivalent of [MA3150 Advanced Mathematical Analysis, or MA3151 Advanced Engineering Mathematics] and [MA3160 Probability and Stochastic Processes or EE3313 Applied Queueing Systems] Programming Knowledge reaching the equivalent of [CS2363 Computer Programming or equivalent] and [EE2331 Data Structure and Algorithms or equivalent]
Precursors: *(Course Code and Title)*	C Programming is required
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	EE4208 Computer Graphics for Engineers

Part II Course Details

1. Abstract

This course aims to provide students with an in depth critical understanding of the principles, concepts, and advanced techniques of computer graphics.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Apply 3D object representation techniques to build up a graphics scene.		✓	✓	
2.	Model and view articulated objects by hierarchical structuring techniques and coordinate transform.		✓	✓	
3.	Apply lighting, shading and rasterization techniques to create a 2D image.		✓	✓	
4.	Apply texture mapping and animation techniques		✓	✓	
5.	Apply and evaluate advanced graphics techniques.		✓	✓	
6.	Create an animation or a game using computer graphics.				✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Lecture	Key concepts are described and explained	✓	✓	✓	✓	✓		2 hrs/wk
Tutorial	Key concepts are illustrated by examples and programming exercises	✓	✓	✓	✓	✓		1 hr/wk (*Some of the tutorials will be conducted in the laboratory)*
Mini project	Each student does a project creating their own original animation or game using techniques learnt in the course						✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5	6		
Continuous Assessment: 50%								
Tests (min.: 2)	✓	✓	✓	✓			30%	
#Assignments (min.: 3)	✓	✓	✓	✓	✓	✓	20%	
Examination: 50% (duration: 2hrs , if applicable)								
Examination	✓	✓	✓	✓	✓		50%	
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

may include mini projects, in-class assignments, and homework assignments.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1	The student will acquire an ability to describe current and anticipated trends in computer graphics through an overview of the field as well as an in depth understanding of selected topics through lectures, tutorials and the mini project.
2	The student will be able to evaluate and analyze new technologies in computer graphics through an understanding of the performance and limitations of current computer graphics technology through lectures, tutorials and the mini project.
3	The student will be able to apply specialist knowledge in the mini projects.
4	The student will be able to assess, evaluate and formulate solutions to problems or specifications in computer graphics through theoretical and practical knowledge learnt during lectures, tutorials and the mini project.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Introduction
Graphics pipeline. Graphics applications.Commercial graphics libraries and packages.

Three Dimensional Object Representations
Object representation methods such as polygon mesh, superquadrics, sweep representation, constructive solid geometry, splines, fractals, and particle systems.

Three Dimensional Geometrical and Modelling Transformation
Homogeneous coordinates. Linear transformations. Composite transformations.
Coordinate system transformations. Hierarchy of transformations and level of details.

Three Dimensional Viewing
Viewing coordinate system. Transformation from world to viewer Coordinates. Parallel and perspective projection. Clipping.

Illumination Models and Surface Rendering
Light sources. Reflections: ambient, diffuse, specular. Polygon rendering methods: flat, Gouraud, Phong. Texture mapping. Bump mapping Image based rendering. Colour Models. Shadow generation on plane. Shadow mapping.

Visible Surface Detection
Back face culling. Z-buffer Algorithm. Ray Casting.

Animation
Key frame and parameterised systems. Morphing. Physical motion simulation.

Advanced Graphics Techniques
Specialist advanced techniques: e.g. global illumination methods (ray tracing and radiosity), shader, modelling techniques for specific objects, advanced animation techniques, speedup techniques by GPU and special architecture. Trend in research and application.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	D. Hearn, M.P. Baker, W.R. Carithers, Computer Graphics with OpenGL, 4th Edition, Pearson (2011),

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	E. Angel, D. Shreiner, Interactive Computer Graphics: A Top-down Approach with Shader-based OpenGL, Addison-Wesley (2012).
2.	A. Watt, 3D Computer Graphics, Addison-Wesley (2000).
3.	G. Sellers, R. S. Wright, N. Haemel, OpenGL Superbible: Comprehensive Tutorial and Reference, Addison-Wesley (2014).