City University of Hong Kong
Course Syllabus

offered by Department of Computer Science
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Virtual Reality Technologies and Applications
Course Code:	CS5188
Course Duration:	One semester
Credit Units:	3 credits
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	CS2303 Data Structures for Media or CS3334 Data Structures or EE3206 Java Programming and Applications
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Virtual reality emphasizes on the construction of interactive 3D virtual/mixed environments, and how to interact within such environments through different sensory channels, such as audio, vision and gesture. Virtual Reality has many applications. The most popular ones include 3D computer games and virtual walkthrough, which have attracted a lot of attention. This course aims at introducing both basic and advanced virtual reality techniques and their applications. It also discusses human factors and evaluation techniques for virtual reality applications.

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.	Identify the important characteristics of different virtual reality techniques.		✓		
2.	Explain different types of virtual reality hardware systems.			✓	
3.	Explain and discuss different types of virtual reality applications.			✓	
4.	Design and apply virtual reality techniques to address real-world problems.				✓
		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 real-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. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Student will engage in formal lectures to gain knowledge about virtual reality technologies and their applications.	✓	✓	✓	✓	2 hours/ week
Tutorial	Students will participate in different class exercises that are relevant to virtual reality technologies and applications. Some of the tutorial exercises will involve the evaluation and design of virtual reality technologies.	✓	✓	✓		1 hour/ week
Group project	Students will participate in groups to consolidate their learning as they produce a program/report, integrating virtual reality techniques in an application under the UnrealEngine framework.		✓	✓	✓	3 hours/ week for 7 weeks

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		
Continuous Assessment: 50%						
Quiz	✓	✓			20%	
Course Project^		✓	✓	✓	30%	
Examination^: 50% (duration: 2 hours)						
					100%	

^ For a student to pass the course, at least 30% of the maximum mark for the examination AND 30% of the maximum mark of the course project must be obtained.

5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Quiz	Capacity in understanding the key concerns of virtual reality techniques	High	Significant	Moderate	Basic	Note even reaching marginal levels
2. Course Project	Ability to apply virtual reality techniques to develop an application in solving real-world problems	High	Significant	Moderate	Basic	Note even reaching marginal levels
3. Examination	Ability to evaluate virtual reality techniques and hardware systems, and to apply them to some applications	High	Significant	Moderate	Basic	Note even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Quiz	Capacity in understanding the key concerns of virtual reality techniques	High	Significant	Moderate	Note even reaching marginal levels
2. Course Project	Ability to apply virtual reality techniques to develop an application in solving real-world problems	High	Significant	Moderate	Note even reaching marginal levels
3. Examination	Ability to evaluate virtual reality techniques and hardware systems, and to apply them to some applications	High	Significant	Moderate	Note even reaching marginal levels

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

1. Keyword Syllabus

(An indication of the key topics of the course.)

Immersive VR. Non-immersive VR. Augmented VR. Telepresence. Interaction Techniques. Advanced Real-time Rendering Techniques. Physically Based Modeling. Motion Capture. Tracking Techniques. Display Systems. Virtual Reality Systems and Applications. Advanced Graphics Systems. Distributed Virtual Environments.

Syllabus

- Virtual Reality Technologies
  Overview of input and output devices for VR: head-mounted display, data gloves, 3D video capture, 3D displays, CAVE, haptic devices, motion tracking.
- Interaction Techniques in Virtual Reality
  3D selection and manipulation techniques, 3D user interface design and evaluation, gesture recognition and tangible interfaces.
- Virtual Environments and Distributed Virtual Environments
  Advanced real-time rendering techniques, visibility determination, motion prediction, motion synchronization, distributed technologies.
- Software Platforms
  Scene graph, Unity3D, Unreal Engine, jMonkey Engine.
- Applications of Virtual Reality
  VR system architecture, applications of VR in different areas such as training, simulation and information visualization, advanced VR applications.
- Human Factors in Virtual Reality
  Evaluations, health and safety, social aspects.

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.)

2.2 Additional Readings

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

1.	*G. Burdea and P. Coiffet, "Virtual Reality Technology," Second Edition, Wiley-Interscience, 2003.*
2.	*Mel Slater, Anthony Steed, and Yiorgos Chrysanthou, "Computer Graphics and Virtual Environments," Addison Wesley, 2002.*
3.	*Jason Jerald, "The VR Book: Human-Centred Design for Virtual Reality," ACM, 2015.*
4.	*Jeff W. Murray, "Building Virtual Reality with Unity and Stream VR," CRC Press, 2017.*
5.	*Mitch McCaffrey, "Unreal Engine VR Cookbook: Developing Virtual Reality with UE5,"Addison-Wesley Professional, 2017.*