# City University of Hong Kong
# Course Syllabus

## offered by Department of Computer Science
## with effect from Semester A 2018/19

---

### Part I    Course Overview

| | |
|---|---|
| **Course Title:** | Virtual Reality Technologies and Applications |
| **Course Code**: | CS5188 |
| **Course Duration:** | 1 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. | Evaluate and critique different types of virtual reality hardware systems. | | | ✓ | |
| 3. | Evaluate and critique 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 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.)*

Teaching pattern:
Suggested lecture/tutorial/laboratory mix: 2 hours lecture; 1 hour tutorial.

| TLA | Brief Description | CILO No. 1 | 2 | 3 | 4 | Hours/week (if applicable) |
|---|---|---|---|---|---|---|
| Lecture | The lecture will focus on the introduction and evaluation of virtual reality technologies and their applications. | ✓ | ✓ | ✓ | ✓ | 2 hours/week |
| Tutorial | Students are required to work on different exercises and case studies that are relevant to virtual reality technologies and applications. Some of the tutorial exercises will involve evaluation and design of virtual reality technologies. | ✓ | ✓ | ✓ | | 1 hour/week |
| Project | Students are required to perform a course project, in which they are encouraged to study and critique the state-of-the art virtual reality techniques/systems and to demonstrate discovery and innovative design and implementation of suitable virtual reality applications to solve real-world problems. | | ✓ | ✓ | ✓ | 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. 1 | 2 | 3 | 4 | Weighting | Remarks |
|---|---|---|---|---|---|---|
| Continuous Assessment: <u>50</u>% | | | | | | |
| Quiz | ✓ | ✓ | | | 20% | |
| Course Project | | ✓ | ✓ | ✓ | 30% | |
| Examination^: <u>50</u>% (duration: 2 hours) | | | | | | |
| | | | | | 100% | |

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

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

| 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 |

**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.* |