1. **Course number and name**
   COE 494-11 – Virtual and Augmented Realities

2. **Credits and contact hours**
   3 credit hours, 3 contact hours

3. **Prerequisites or co-requisites**
   Prerequisites: COE 312 or CMP 256

4. **Name and Contact Information of Instructor**
   Dr. Hicham H. Hallal
   Office: EB2-102
   Email: hhallal@aus.edu
   Phone: (06) 515-2908
   Office Hours: as posted on *iLearn* or by appointment

5. **Course Description (Catalog Description)**
   Focuses on the main hardware and software aspects of Virtual Reality (VR) and Augmented Reality (AR) systems and on the integration of AR and VR technologies in the development of computer games and other engineering applications. Covered topics include: creation and rendering 3D models, inertial measurement units (IMUs) and sensors, scene management, user interactivity, performance evaluation, single and multiplayer games, use of patterns in game development. The course includes a project component that involves developing a real application.

6. **Textbook, title, author, and year**
   Recommended:
   - Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, ACM Books, 2015.
   - Jonathan Linowes, Unity Virtual Reality Projects: Explore the world of virtual reality by building immersive and fun VR projects using Unity 3D, 2015.

   **Supplemental material**
   - Tony Parisi, Learning Virtual Reality, O'Reilly Media, Inc., 2015
   - Eloquent JavaScript, Marijn Haverbeke, 3rd edition.
   - Handouts and Lecture notes through iLearn.

7. **Specific goals for the course**
   Upon completing the course, students will be able to:
   1. Understand the main concepts and technologies involved in developing AR and VR systems.
   2. Analyze and evaluate the hardware requirements for developing AR and VR systems.
   3. Analyze and evaluate the software requirements for developing AR and VR systems.
   4. Use development environments to build AR and VR based applications.

5. Design and develop a computer game application using AR and VR technologies.
6. Identify and evaluate the usage of relevant design patterns in the development lifecycle of AR/VR applications.

8. **Teaching and Learning Methodologies**

Methods include lectures and class discussions, practical demonstrations, invited talks, homework assignments, and a project.

**9. Course Topics and Schedule:**

| Topic | Weeks |
|---|---|
| Introduction: Immersive environments: AR , VR, and Computer games | 1 |
| VR and AR hardware | 2 |
| 3D graphics for VR and AR | 2 |
| User interactivity in VR and AR systems | 2 |
| IMUs and sensors | 2 |
| Introduction to Unity 3D | 2 |
| Game design and development | 2 |
| Multiplayer game development | 1 |
| Advanced topics in game development | 1 |
| Assessment and project evaluation | 1 |
| Total | 16 |

**10. Schedule of Laboratory and other Non-Lecture Sessions:**

N/A

**11. Out-of-Class Assignments with Due Dates**

| Assignment | Due Date (tentative) |
|---|---|
| Homework 1 | 3rd week |
| Homework 2 | 6th week |
| Homework 3 | 8th week |
| Homework 4 | 10th week |
| Homework 5 | 12th week |
| Project | 14th week |

**12. Student Evaluation and Grading System**

| Item | Date (tentative) | Weight |
|---|---|---|
| Midterm Exam | **Week 8** | 25% |
| Project | Week 14 | 20% |
| Final Exam. | **Week 15** | 35% |
| Assignments | As per Section 11 | 10% |
| Attendance & Participation | TBD | 5% |
| Quizzes | TBD | 5% |

## 13. Course Project Description:

The project aims at enhancing the student abilities to apply the concepts learned in class in the context of designing computer games using AR and VR systems. The students work in groups. The project will be evaluated based on the report submitted at the end of the term and a live demo of the developed game.

## 14. Assessment Instruments:

| Assessment | Course Learning Outcomes |
|---|---|
| Quizzes, Assignments and Participation | O1 – O6 |
| Project | O1 – O6 |
| Midterm Exam | O1 – O4 |
| Final Exam | O1 – O6 |

## 15. Contribution of Course to Program Outcomes

| BSCoE Program Outcomes | Emphasis in this course | Course Learning Outcomes |
|---|---|---|
| (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. | ◑ | O1, O2, O3 |
| (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors | ● | O1, O5 |
| (3) an ability to communicate effectively with a range of audiences | ◑ | O4, O6 |
| (4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts | | |
| (5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and | ◑ | O5, O6 |

| | | |
|---|---|---|
| inclusive environment, establish goals, plan tasks, and meet objectives | | |
| (6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions | ◑ | O2, O3, O4 |
| (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. | | |

Emphasis: ● High; ◑ Medium; ○ Low; Blank – Nothing Specific Expected

| **BSCS Program Outcomes** | **Emphasis in this course** | **Course Learning Outcomes** |
|---|---|---|
| (1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. | ◑ | O1, O2, O3 |
| (2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. | ● | O4, O5, O6 |
| (3) Communicate effectively in a variety of professional contexts. | ◑ | O4, O5, O6 |
| (4) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. | | |
| (5) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. | ◑ | O6 |
| (6) Apply computer science theory and software development fundamentals to produce computing-based solutions. | ◑ | O4, O5, O6 |

Emphasis: ● High; ◑ Medium; ○ Low; Blank – Nothing Specific Expected

## 16. Letter Grade Policy

| Letter Grade | GPA | Points Needed |
|---|---|---|
| **A** | 4.00 | 93.00-100 |
| **A-** | 3.70 | 89.00-92.99 |
| **B+** | 3.30 | 85.00-88.99 |
| **B** | 3.00 | 80.00-84.99 |

| | | |
|---|---|---|
| **B-** | 2.70 | 77.00-79.99 |
| **C+** | 2.30 | 75.00-78.99 |
| **C** | 2.00 | 70.00-74.99 |
| **C-** | 1.70 | 65.00-69.99 |
| **D** | 1.00 | 60.00-64.99 |
| **F** | 0.00 | < 60.00 |