Universidad Zaragoza

**Academic Year/course: 2022/23**

# 62228 - Computer Graphics and immersive multimedia environments

## Syllabus Information

**Academic Year:** 2022/23
**Subject:** 62228 - Computer Graphics and immersive multimedia environments
**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura
**Degree:** 534 - Master's Degree in Informatics Engineering
**ECTS:** 6.0
**Year:** 1
**Semester:** Second semester
**Subject Type:** Compulsory
**Module:**

## 1. General information

### 1.1. Aims of the course

This course focuses on the general topic of visual computing, and in particular on its scientific foundations and its applications in industry and science. Visual computing is a largely relevang field in modern computer science, and it has a widespread presence in mostly all aspects of modern life.

It is expected that after passing the course, the student will be able to:

- Have a general perspective on the field of visual computing, including its evolution, state of the art, and open problems.
- Communicate to a general audience the acquired knowledge on visual computing.
- Understand the mathematical models and computational algorithms used in visual computing.
- Elaborate R+D projects.
- Design hardware and software products for solving problems in visual computing.
- Create and leverage virtual enviroments, including virtual, mixed, and augmented reality, as well as multimedia content and populated virtual environments.

These goals are aligned with the following Sustainable Development Goals in the UN Agenda 2030 (https://www.un.org/sustainabledevelopment/es/):

- Goal 8: Decent work and economic grow.
- Goal 9: Industry, innovation and infrastructures.

### 1.2. Context and importance of this course in the degree

This course focuses on providing a global perspective on the state of the art of visual computing, from the generation of synthetic images and virtual worlds, to automatic image processing. This global perspective includes a historical overview of the field, as well as its applications in industry and science.

### 1.3. Recommendations to take this course

The course has no special requirements.

## 2. Learning goals

### 2.2. Learning goals

**After passing the course, the student will demonstrate the following results:**

1. Understand the theoretical and practical bases of synthetic image generation, including the foundamental algorithms in computer graphics, the theoretical basis of light transport, and the use of graphics hardware. He/she will know the historical evolution of the field, and its applications in entertainment, CAD, architecture,...

2. Know the concepts of Virtual Reality, Augmented Reality and Mixed Reality; understand their application, how virtual environments are implemented, and how can be coupled and populated using intelligent agents.

3. Know the theoretical basis of 3D reconstruction and localization in real environments, and its integration in Augmented and Mixed Reality.

### 2.3. Importance of learning goals

The field of visual computing is an important field in computer science, and has a widespread impact in most aspects of modern life, including industry, enterteinment, advertising, teaching... The course gives a wide overview of the field as a whole.

## 3. Assessment (1st and 2nd call)

### 3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

**The evaluation of the learning results of the student will be done using the following activities:**

- Final written exam (40%)
- Practical assignments (50%)
- Presentations and participation (10%)

To pass the course, the students will need to have a minimum weighted average of 5/10, and at least a grade of 4/10 on each evaluation activities. If the grade of any of the activities is below 4, the maximum grade will be 4/10. Students not opting or passing the evaluation described previously, or wanting to increase their grade, will have the right to pass through a global evaluation.

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as:

- The learning of concepts and techniques through theoretical classes, in which the participation of students will be encouraged.
- The study of the course contents by the students, and participation in class when solving the proposed problems.
- The preparation of practical assignments by the students, guided by the professors, that favor the assimilation of theoretical knowledge.

Please note that the course has both a theoretical and a practical orientation. Thus, the learning process emphasizes both student attendance to class and the elaboration of the practical assignments, as well as personal study.

The teaching and learning activities are based on:

1. **Lectures.** Exposition of contents by means of presentation or explanation by a lecturer (possibly including demonstrations). Participation will be encouraged.
2. **Practical classes**. Practical activities carried out with computers.
3. **Evaluation**. Set of written, oral and practical tests, projects, assignments, etc. used in the evaluation of student progress.
4. **Tutorized assignments.** Projects which are larger than the practical classes, which will be handed and presented.
5. **Study.** Self-study of the contents presented, including any study activity which has not be computed in the previous section (studying, library work, complementary reading, doing problems and exercises, etc.)

## 4.2. Learning tasks

The course (150 hours, 6 ECTS credits) includes the following learning tasks:

- Lectures and practical sessions: 60 hours
- Practical application or research assignments: 60 hours
- Study: 25 h
- Evaluation tests: 5h

## 4.3. Syllabus

The course will address the following topics:

Section 1:

- Fundamentals of Computer Graphics and synthetic image generation
- Real time Computer Graphics

Section 2:

- Light transport
- Global illumination
- Participating media

Section 3:

- Multiview geometry modeling for computer vision
- Structure from Motion (SfM)
- Visual SLAM (Simultaneous Localization and Mapping)

Section 4:

- Interactive environments. Interaction paradigms and styles
- Inmersive environments
- Populated environments

## 4.4. Course planning and calendar

There will be lectures, problem solving, practical classes, assignments, and tutorized projects.

Information concerning the schedule, office hours, assessment dates, deliverables due dates, and other details regarding this course, will be provided through the centre or course websites in a timely manner.

## 4.5. Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=62228&year=2019