COURSE DATA

DATA SUBJECT

Code: 36480
Name: Fundamentals of computer graphics
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1407 - Degree in Multimedia Engineering	Escola Tècnica Superior d'Enginyeria	2	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1407 - Degree in Multimedia Engineering	Gráficos y Audio por Computador	COMPULSORY

COORDINATION

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SUMMARY

The subject *Foundations of Computer Graphics* is part of Computer Graphics and audio matter. Its overall objective is to introduce the students in the foundations and the basic techniques used in the generation of bi-and three synthetic images in graphics applications. It is a compulsory subject that is taught quarterly basis in the second year of the degree of Bachelor in Multimedia Engineering during the first quarter. The curriculum consists of a total of 6 ECTS.

The course has two main theoretical and practical. Need to expose students to the theoretical basis on which these techniques are based to be able to cope with problems or unforeseen contingencies in the tools and libraries available. Moreover, it is imperative that students become familiar through practice, with standard forms of work in these fields using one of the most used tools and libraries that exist to generate charts.

The student should be able to manage the technical vocabulary of these fields and to evaluate and argue pros and cons of using the various techniques presented. Besides, the student should use the contents presented to propose solutions to specific problems of the subject. In this regard, the oral presentations of proposed topics and sessions of problems in this group are intended to assist the student in the task of synthesis, abstraction and understanding necessary for the proper assimilation of the content.

The dynamics of the class is participatory. The dynamics of theoric classes consist on establish a student-teacher and student-student dialogue through formulation of issues by both the teacher and the student. In the problems classes, activities that encourage group discussion and oral presentation by students will be developed . In laboratory work is carried out through in teams of two people and presented to the teacher preferably through a dialogue that promotes a reasoned explanatory argument. The tutoring sessions are

voluntary but are an important part of the accommodation the student to the dynamics of the subject and they are the place not only to answer specific questions about the concepts presented, but also to raise any problem or difficulty in any aspect of the subject.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

The course, given its basic nature, does not need a specific background, although it is recommended have completed the courses of Informática, Programación and MatemáticasI and II. The first two serve to equip students with skills in the use of libraries and coding programs. The last two give the student the ability to understand the geometric problems and use mathematical formalism that arise in the course.

COMPETENCES / LEARNING OUTCOMES

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G1 - Be able to relate and structure information from different sources and to integrate ideas and knowledge. (RD1393/2007)

G2 - Have the learning skills needed to undertake further studies or to gain further training with a certain degree of autonomy. (RD1393/2007)

G4 - Be able to integrate into working groups and collaborate in multidisciplinary environments and be able to communicate properly with professionals from all fields.

I2 - Know, design and make an efficient use of the data types and data structures that are most suited to solving a problem.

MM12 - Know current 2D and 3D graphic systems and their application to multimedia developments.

MM1 - Have knowledge and ability to understand essential facts, concepts, principles and theories related to multimedia systems including all the disciplines covered by these systems.

MM28 - Be able to solve problems with initiative, decision-making and creativity and to communicate and transmit the knowledge, abilities and skills of a multimedia engineer.

MM2 - Be able to understand and manage the different technologies involved in multimedia systems, both from the point of view of hardware and electronics and of software.

MM3 - Be able to implement methodologies, technologies, processes and tools for the professional development of multimedia products in a real context of use by applying the appropriate solutions for each environment.

MM9 - Program correctly in the different specific languages of multimedia systems taking into account time and cost restrictions.

DESCRIPTION OF CONTENTS

1. Introduction to Computer Graphics

Areas of application of synthetic graphics.
The graphics pipeline
Graphics Hardware: Model raster graphics devices.
Graphics hardware: GPUs

2. Introduction to Modelling

Geometric Modeling. Fundamental concepts. faces, normal vectors,...
Polygonal Modeling. Indexed and double indexed representations, tables.
Basic Polygonal Structures.

3. Geometric Transformations

Basic 2D geometric transformations. Homogeneous coordinates.
Transformations known the end position. Direction cosines.
Basic 3D Geometric Transformations
The transformations in the OpenGL library

4. View Transformation

World window and Viewport.
Algorithms for 2D Clipping
Transformation of 3D view.
View Volume
The transformation of view in the OpenGL library

5. Planar linear Projections

Parallel and Perspective Projections
General matrix projection
Implementation of the Projection transformation
Implementation in the OpenGL library

6. Primitive drawing and pixel operations

Line drawing algorithms
Algorithms for circles.
Filling figures. Filling XY Alg.
Filling by seed Alg. based on bilinear fill with various colors
Hiding Algorithm Z-buffer

7. Lab. Practice

Practice 1: OpenGL and GLUT graphic libraries and event-driven programming
Practice 2: Using a 3D modeler
Practice 3: 3D affine transformations
Lesson 4: Transforming 3D view
Practice 5: Projections
Lesson 6: Drawing Primitives
Lab 7: Algorithms filling / Project
Lab 8: Project

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Laboratory	20,00
Classroom practices	10,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	8,00
Independent study and work	12,00
Preparation of lessons	50,00
Preparation for assessment activities	0,00
Resolution of case studies	20,00
Total hours	**90,00**

TEACHING METHODOLOGY

The development of the subject is structured around three work environments: learning with the teacher (theory sessions, problems and face-to-face tutoring), laboratory sessions and group work.

Group learning with the teacher

Theory sessions will use the master class model. In them the teacher will expose the fundamental contents of the subject, using the audiovisual means at his disposal (presentations, transparencies, blackboard, demonstrations).

In the problem sessions, the dynamics will be eminently directed by the student. Students are expected to participate in explaining the proposed problems. For this, previously the teacher will indicate what day is going to be dedicated to solving problems and what problems are to be solved, so that the student attends these classes with the problem statement prepared in advance.

Team work.

Throughout the course, students will carry out different classroom activities in pairs or in larger groups. In these activities, apart from the assimilation of content, they are focused on collaborative work learning. Where the students must explain and convince the rest of the group and distribute the tasks.

Laboratory sessions

In the laboratory sessions the OpenGl graphic library will be used as well as additional software to carry out the proposed work. The work will be reviewed in the sessions of tutorials arranged for this purpose in which the students will explain the realization of the practice to the teacher and a dialogue will be maintained about technical aspects involved in the development of the same.

These laboratory sessions will be organized around working groups made up of a maximum of two people.

Tutoring

Students will have a schedule of tutoring whose purpose is to solve problems, questions, and the presentation of the proposed work in the laboratory. The schedule of these tutorials will be indicated at the beginning of the academic year. They will also have the opportunity to clarify some doubts by email or discussion forums by using the "Virtual Classroom" tool, provided by the University of Valencia.

EVALUATION

Evaluation System
This system encourages students to participate regularly in training activities, evaluating theoretical activities, problem sessions, presentation of work and lab activities.

It is mandatory that the student notify the difficulties to attend the presential classes, to be specifically instructed about the evaluation mode. The student must communicate these diffuculties along the two first weeks of the course.

In the normal evaluation (daily class attendance), the grade will have the following weights

Theoretical activities: With a total weight of 50%. Exams (80%) . Other activities (lectures, works about a subject, activities inside the classroom)(20%)

Problems: 10% of the total weight

Labs: 40 % of the total weight

The minimum mark to weight each of the concepts of the table above to be evaluated is 4.5

First call:

One or several partial exams will be carried out along the term plus a final exam.

The final mark of the Exams part is calculated as:

Mean_mark = 0.25 *Partial_Exams + 0.75 * Final_Exam

It is necessary to get a 4.5 mark in each exam to weight the correspondent term. To get a 4.5 mark in the Final exam is mandatory.

Second call:

-The percentages will be the same than those of first call. However, the marks obtained in the partial exams are not considered, being substituted by the mark obtained in the final exam of this second call.

- they won't be re-evaluated in this second call the following items: work about a subject, activities in the classroom and lab. work

-Parts non re-evaluated won't be subjected to the restriction of getting a minimum mark

To get a 4.5 mark in the Final exam is mandatory.

The implementation of practices and their attendance is mandatory. Special cases should be discussed with the teacher.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing

the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

The evaluation of the course will be done in accordance with the Regulation of evaluation and qualification of the University of Valencia for the undergraduate and master degrees approved by the Governing Council of May 30, 2017 (ACGUV 108/2017).

REFERENCES

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- Computer Graphics with OpenGL (4th Edition) (Segunda edición en castellano) . D. Hearn, M.P. Baker, W. Carithers. Ed. Pearson. 2010
- Foundations of 3D Computer Graphics. Gortler, S.J. MIT Press 2012