Course guide
804222 - FIS1VJ - Physics

Last modified: 15/09/2024

Unit in charge: Image Processing and Multimedia Technology Centre
Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre.

Degree: BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: MIQUEL SUREDA

Others: DAVID DEL CAMPO SUD

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Analyse, decide upon and apply graphic programming techniques, physics, artificial intelligence, interaction, augmented reality and networks to a video game project.

Generical:
2. Interpret and master the basic concepts of the general laws of mechanics, thermodynamics, fields and waves and electromagnetism; and their application for solving engineering problems.

TEACHING METHODOLOGY

Expository method / master class.
Participative class.
Laboratory practice with computer.
Learning based on problems and on presentations and defence of topics or work.
Autonomous work.

Planning of activities
1. Presentation of new contents and description of the study materials (teacher).
2. Formulation of questions from the students to the teacher, in relation to the contents that he/she is telling in the master class.
3. Raising of doubts by the students, in relation to the contents studied since the last class and review of the results of the exercises or practices developed in the autonomous work. Apart from the teacher, other students can collaborate by resolving doubts and reviewing exercises of other classmates.
4. Explanation, defence or revision of the exercises or laboratory practices with computer solved or in the process of resolution, that is to say, monitoring the development of the practice.
5. Individual or team work, in which students begin or continue the development of exercises, computer-based laboratory practices or projects, with the support of the lecturer in the classroom.
6. Preparation and performance of evaluation tests.
7. Students, working autonomously outside class hours, study the contents taught by the lecturer, using notes and other materials provided by the lecturer or obtained by the student himself/herself.
8. Students, working independently, outside class hours, individually or in teams, solve problems or exercises or carry out laboratory practices with a computer.
The course consists of 4 hours per week of face-to-face classes in the classroom (large group): 2 hours of theory and 2 hours of practice.

LEARNING OBJECTIVES OF THE SUBJECT

- Use the basic laws of mechanics.
- Learn the basic principles of electromagnetism. Understanding the effects associated with electric and magnetic fields.
- Use basic knowledge for the study of wave phenomena, and in particular, its effects on the various elements that could be part of a game or animation realistic.
- Know and understand the principles of mechanics typically associated with game development: direct and inverse kinematics; collision detection. Relative motion.
- Understand the basic principles of game engine software and its appropriate use.
- To obtain valid experimental results, analyze them and discuss them properly.
- Being able to assess the efficiency and utility of the methods and tools for modeling and simulation in the usual video game design and programming and realistic animations.
- To critically analyze the results.
- Solving problems related to the basics.
- Planning oral communication, respond appropriately to the questions posed and write texts with basic spelling and grammar.
- Engage in teamwork and positive contributions once the objectives and individual and collective responsibilities and jointly decide the strategy to be followed.
- Identify information needs and use collections, spaces and services available to design and run simple searches appropriate to the topic.
- To carry out the tasks assigned on time, working with information sources, according to the guidelines set by teachers.
- Demonstrate sufficient comprehension in reading documents written in English, related to the subject, such as notes taken in class, scientific articles, popular articles, websites, etc.

STUDY LOAD

Type	Hours	Percentage
Guided activities	10,0	6.67
Self study	90,0	60.00
Hours large group	34,0	22.67
Hours medium group	16,0	10.67

Total learning time: 150 h

CONTENTS

Introductory Physics

Description:
Introduction and review of basic physics and mathematical tools:
- Magnitudes, units and dimensions, significant digits, scientific notation, magnitude order.
- Coordinate systems and relative position.
- Basics on vector and differential calculus.

Specific objectives:
Learn and review basic physical and mathematical concepts: systems of units, dimensional analysis, vector algebra.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 14h
Practical classes: 4h
Guided activities: 2h
Self study : 8h

Kinematics

Description:
Description of the motion in 2D:
- Basics on kinematics: path, velocity and acceleration.
- Movement equations: Uniform and non-uniform
- Circular movement.

Specific objectives:
Learn how to understand and how to calculate the trajectory that describes a free point particle in two dimensions, in order to apply it in the dynamics of specific objects in simple videogames.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 30h
Practical classes: 10h
Guided activities: 2h
Self study : 18h

Dynamics

Description:
Description of linear and circular movement under force action:
- Newton's law and force balance.
- Contact forces and friction.
- Relative movement: inertial- non inertial frames.

Specific objectives:
Studying the motion of bodies in mobile coordinate systems, understand how to change from a fixed coordinate system to the mobile one and vice versa.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 30h
Practical classes: 10h
Guided activities: 2h
Self study : 18h

Energy

Description:
Description of energy conservation and derived physics:
- Potential, kinetic and elastic energy.
- Energy conservation.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 26h
Practical classes: 10h
Self study : 16h

Collisions

Description:
Description kinematics under collision conditions in 1D and 2D:
- Momentum conservation.
- Collisions in 1D and 2D: elastic and fully inelastic, non frontal collisions.

Specific objectives:
Learn the basics of a collision between particles in two dimensions, the variety of existing collisions and their numerical treatment. Predict the angles, velocities and trajectories out in a collision.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 30h
Practical classes: 10h
Guided activities: 2h
Self study : 18h

Harmonic movement

Description:
Basics on oscillatory movement:
- Oscillatory movement: waves.
- Simple harmonic motions.

Specific objectives:
Understanding the basic physical characteristics of the oscillatory motion and wave as the preamble to the study of light.

Related activities:
Theoretical lessons, exercises, computer-assisted practice.

Full-or-part-time: 20h
Practical classes: 6h
Guided activities: 2h
Self study : 12h

GRADING SYSTEM

The qualification of the subject will be obtained following a system of continuous evaluation. There will be one written tests during the course (partial exam), two (2) group projects and one (1) final exam.
The weight of each part is as follows:

Partial Exam: 20%
Final Exam: 30%
Group Project 1: 20%
Group Project 2: 20%
Participation: 10%

If the pass mark is not obtained, there is the possibility of a reevaluation exam and the obtained qualification will substitute those of the partial exams and the final exam. The maximum mark to be obtained in the reevaluation is 5.

Irregular actions that may lead to a significant variation of the grade of one or more students constitute a fraudulent performance of an evaluation act. This action entails the descriptive grade of failure and a numerical grade of 0 for the ordinary global evaluation of the course, without the right to re-evaluation.

If the lecturers have indications of the use of AI tools not allowed in the evaluation tests, they may summon the students concerned to an oral test or a meeting to verify the authorship.

BIBLIOGRAPHY

Basic:
- Tipler, P.A. Física: para la ciencia y la tecnología [on line]. 6a ed. Barcelona [etc.]: Reverté, 2010 [Consultation: 06/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10372.
- Giró, A. [et al.]. Física per a estudiants d'informàtica [on line]. Barcelona: UOC, 2005 [Consultation: 06/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=3206945. ISBN 8497881443.
- Eberly, D.H. Game physics [on line]. 2nd ed. Burlington, MA: Morgan Kaufmann/Elsevier, 2010 [Consultation: 06/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=648814. ISBN 9780080964072.
- Erleben, K. [et al.]. Física para videojuegos. [s.l.]: Cengage Learning, 2011. ISBN 9786074815061.
- Tipler, P.A.; Mosca, G. Physics for scientists and engineers. 6th ed. New York: W.H. Freeman and Company, 2008. ISBN 9781429201339.

Complementary:
- Gettys, W.E.; Keller, F.J.; Skove, M.J. Física: clásica y moderna. Madrid [etc.]: McGraw-Hill, DL 1991. ISBN 8476156359.

RESOURCES

Other resources:
- Website: Física con ordenador. Autor: Ángel Franco.
http://www.sc.ehu.es/sbweb/fisica/default.htm />
- Programmable creation and modeling tool.
https://ccl.northwestern.edu/netlogo