Course guides
804222 - FIS1VJ - Physics

Last modified: 01/09/2021

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: 2021 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: DAVID DEL CAMPO SUD

Others:

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

Method Presentation / Lecture:
The course consists of 2 hours a week of lecture and 2 hours of laboratory practice.
Class participation is required. The classroom will be an active learning environment where students are encouraged to participate in the lectures and solve problems in class when asked.
Computer lab based activities will be periodically assigned.
Students are expected th show a basic understanding and solving of problems.
Self-learning is imperative as all homework will be completed outside of classtime.

Planning of activities:
1. Presentation of new content and problem solving techniques. Description of study materials (teacher).
2. Active learning platform: Students must participate in class in the form of answering questions or solving problems based on the lesson content.
3. Homework must be completed outside of class. Each student must turn in their own work, but are allowed to work together in groups to solve the assigned problems. There will be zero-tolerance for plagarism.
4. Students will review the homework with the teacher in class and raise doubts about the material when needed.
5. Working individually or in teams, the students will begin or continue development exercises, computer lab practices or projects with the support of the teacher in the classroom.
6. Preparation and testing of individual progress will be carried out with weekly short quizzes.
7. Students must be able to work independently outside of class time. They must be able to study the content taught by the teacher through their own notes, other materials provided by the instructor, and supplementary electronic resources.

LEARNING OBJECTIVES OF THE SUBJECT

- Learn and use the basic laws of mechanics. Calculation of particle trajectories in the classical radial force fields. Moving under the gravitational field.
- 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
Hours medium group	16,0	10.67
Hours large group	34,0	22.67
Self study	90,0	60.00

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.

BIBLIOGRAPHY

Basic:
- Tipler, P.A.; Mosca, G. Physics for scientists and engineers. 6th ed. New York: W.H. Freeman and Company, 2008. ISBN 9781429201339.
- Tipler, P.A. Física: para la ciencia y la tecnología. 4a ed. Barcelona [etc.]: Reverté, 2000. ISBN 842914384X.
- Giró, A. [et al.]. Física per a estudiants d'informàtica [on line]. Barcelona: UOC, 2005 [Consultation: 21/12/2016]. Available on: http://site.ebrary.com.recursos.biblioteca.upc.edu/lib/upcatalunya/detail.action?docID=10646191. ISBN 8497881443.
- Eberly, D.H. Game physics [on line]. 2nd ed. Burlington, MA: Morgan Kaufmann/Elsevier, 2010 [Consultation: 21/12/2016]. Available on: http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10427976. ISBN 9780080964072.
- Erleben, K. [et al.]. Física para videojuegos. [s.l.]: Cengage Learning, 2011. ISBN 9786074815061.

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