804222 - FIS1VJ - Physics

Coordinating unit: 804 - CITM - Image Processing and Multimedia Technology Centre
Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre
Academic year: 2017
Degree: BACHELOR’S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Teaching unit Compulsory)
BACHELOR’S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: MARIA DE LOS ANGELES FERNÁNDEZ MORA
Others: MIGUEL ÁNGEL GUTIÉRREZ ANTUÑANO

Opening hours
Timetable: To be determined.

Degree competences to which the subject contributes

Specific:
1. (ENG) Analitzar, decidir i aplicar tècniques de programació gràfica, física, intel·ligència artificial, interacció, realitat augmentada i xarxes a un projecte de videojoc.

General:
2. (ENG) Interpretar y dominar los conceptos básicos sobre las leyes generales de la mecánica, la termodinámica, los campos y las ondas y el electromagnetismo; y su aplicación para la resolución de problemas propios de la ingeniería.
# 804222 - FIS1VJ - Physics

## 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 to show a basic understanding and solving of problems.
Self-learning is imperative as all homework will be completed outside of class time.

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 plagiarism.
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.
<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>34h</th>
<th>22.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>16h</td>
<td>10.67%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>10h</td>
<td>6.67%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</table>
**Content**

### Introductory Physics

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>14h</th>
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</thead>
<tbody>
<tr>
<td>Practical classes:</td>
<td>4h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>8h</td>
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</table>

**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.

**Related activities:**
Theoretical lessons, exercises, practices with computer

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

### Kinematics

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>30h</th>
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</thead>
<tbody>
<tr>
<td>Practical classes:</td>
<td>10h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>18h</td>
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</table>

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

**Related activities:**
Theoretical lessons, exercises, practices with computer

**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.
## Dynamics

<table>
<thead>
<tr>
<th>Learning time: 30h</th>
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<tbody>
<tr>
<td>Practical classes: 10h</td>
</tr>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 18h</td>
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</tbody>
</table>

**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

**Related activities:**
Theoretical lessons, exercises, practices with computer

**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.

## Energy

<table>
<thead>
<tr>
<th>Learning time: 26h</th>
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<tbody>
<tr>
<td>Practical classes: 10h</td>
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<tr>
<td>Self study: 16h</td>
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</table>

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

**Related activities:**
Lectures, practical exercises, practices with computer
### 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.

**Related activities:**
Theoretical lectures, applications and practices based on computer.

**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.

<table>
<thead>
<tr>
<th>Learning time: 30h</th>
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<tbody>
<tr>
<td>Practical classes: 10h</td>
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<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study : 18h</td>
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### Harmonics

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

**Related activities:**
Lectures, exercises and practical application with computer.

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

<table>
<thead>
<tr>
<th>Learning time: 20h</th>
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<tbody>
<tr>
<td>Practical classes: 6h</td>
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<tr>
<td>Guided activities: 2h</td>
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<tr>
<td>Self study : 12h</td>
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</tbody>
</table>
### Planning of activities

<table>
<thead>
<tr>
<th>ACTIVITY 1: LECTURES AND PRACTICAL EXERCISES</th>
<th>Hours: 60h</th>
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<tbody>
<tr>
<td>Self study: 30h</td>
<td>Theory classes: 30h</td>
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**Description:**
- Development of theoretical concepts and supervision of practical exercises.

**Support materials:**
- Course notes.
- Collections of problems.

**Descriptions of the assignments due and their relation to the assessment:**
- Weekly.

<table>
<thead>
<tr>
<th>ACTIVITY 2: TUTORIAL EXERCICES (5)</th>
<th>Hours: 12h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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</table>

<table>
<thead>
<tr>
<th>ACTIVITY 3: COMPUTER BASED PRACTICES (5)</th>
<th>Hours: 60h</th>
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<tbody>
<tr>
<td>Laboratory classes: 30h</td>
<td>Theory classes: 30h</td>
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</tbody>
</table>

**Description:**
- Development of practical activities using computer simulation programs suitable to represent physical systems.

**Support materials:**
- List of simulation practices adapted to the representation of physical systems used in video games.

**Descriptions of the assignments due and their relation to the assessment:**
- Each 2 weeks.

<table>
<thead>
<tr>
<th>ACTIVITY 4: INDIVIDUAL EVALUATION TESTS</th>
<th>Hours: 18h</th>
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</thead>
<tbody>
<tr>
<td>Laboratory classes: 8h</td>
<td>Self study: 10h</td>
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</table>
Qualification system

Subject qualification follows a continued evaluation system. There will be two written tests during the course (Partial I and Partial II), five (5) tutorial exercises (TE) and five (5) computer tutorials to be submitted within the corresponding deadline, and a final exam.

The weights of each part are the following:

<table>
<thead>
<tr>
<th>Part</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Partial Exam I</td>
<td>20 %</td>
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<tr>
<td>Partial Exam II</td>
<td>20 %</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20 %</td>
</tr>
<tr>
<td>Tutorial exercises (5)</td>
<td>10 %</td>
</tr>
<tr>
<td>Computer tutorials (5)</td>
<td>20 %</td>
</tr>
<tr>
<td>Participation</td>
<td>10 %</td>
</tr>
</tbody>
</table>

The pass degree is obtained on getting at least a mark of 5 in the final evaluation, computed by considering the weights detailed above. Miss-submitting an exam or tutorial exercise results on a null mark for that deliverable. At least, the 60% of deliverables should be submitted/attended. On the contrary, the student will be considered as NOT PRESENTED.

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.

Regulations for carrying out activities

In-class exercises:
During the theory lectures, student will develop exercises to be discussed and solved in the same lecture. These exercises act as training to further do the Tutorial Exercises (individual).

Tutorial Exercises (TE):
At the beginning of each package, the corresponding tutorial exercises (TE) will be delivered, and should be submitted within the indicated deadline, in pdf format. Complementary material (Excel, Matlab, Phyton), if convenient, should be submitted as well.

Computer tutorials (T):
Computer tutorials should be submitted within the indicated deadline, in pdf format. Complementary material (Excel, Matlab, Phyton), if convenient, should be submitted as well.
Bibliography

Basic:


Others resources: