Course guides
370003 - FISICA - Physics

Unit in charge: Terrassa School of Optics and Optometry
Teaching unit: 731 - OO - Department of Optics and Optometry.

Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2020). (Compulsory subject).

Academic year: 2020  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: Núria Lupón Bas
Others: Montserrat Tapias Anton
Armengol Cebrian, Jesus

PRIOR SKILLS

As can be seen in the topics section, the course is very basic in nature. For this reason, the previous knowledge required to be able to take advantage of the course is minimal. Any student who has been admitted to the bachelor’s degree in Optics and Optometry will be able to benefit from the course.

Having the knowledge provided from upper secondary school-level physics and mathematics will help students follow the course more comfortably.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE01. (ENG) The ability to understand the behaviour of fluids and surface phenomena. The ability to understand wave phenomena stemming from oscillations and mechanical waves. The ability to understand from electric and magnetic fields to the electromagnetic field and electromagnetic waves.
CE07. (ENG) The ability to understand and manage basic laboratory materials and techniques.
CE11. (ENG) The ability to understand the physical and chemical properties of the materials used in optics and optometry.

CE08. (ENG) The ability to understand light propagation in isotropic media, light-matter interactions, light interference, diffraction phenomena, the properties of single- and multi-layer surfaces and the principles and applications of lasers.

Generical:
CG11. (ENG) The ability to locate new information and interpret it in context.

Transversal:
CT4. (ENG) Teamwork. The ability to work as a member of an interdisciplinary team, as just another member or in a leadership role, who can contribute to developing projects pragmatically and with a sense of responsibility and make commitments that take into account the resources that are available.
TEACHING METHODOLOGY

MD1 - Participatory lecture on theory and problems.
MD3 - Practical problem-solving class requiring student participation in case studies and/or exercises on topics related to the subject matter.
MD4 - Laboratory practicals.
MD6 - Completing problems, exercises and assignments, and resolving doubts via the ATENEA virtual campus.
MD7 - Tutorials.

LEARNING OBJECTIVES OF THE SUBJECT

1. To understand the behaviour of fluids, oscillations and mechanical waves.
2. To understand electric and magnetic fields to the point of becoming the electromagnetic field and electromagnetic waves.
3. To use basic laboratory techniques and equipment to record, depict and interpret experimental data.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>45,0</td>
<td>30.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h
## Contents

### Solid and fluid mechanics

**Description:**


**Specific objectives:**
- To understand and describe the concept of the density of a substance.
- To calculate, using Hooke’s law, the deformations, which are of special interest in some cases, that are produced on a body when a force is applied.
- To describe the concepts of pressure within a fluid, the flow of a fluid stream and the viscosity of fluids.
- To apply the basic laws of perfect and viscous fluid statics and dynamics in laminar and stationary flow regimes to simple problems and situations involving fluids at rest and/or in motion.
- To qualitatively describe the role that cohesive forces play in liquids and that adhesive forces play in solids and liquids in cases pertaining to optometry.

**Full-or-part-time:** 46h
- Practical classes: 15h
- Laboratory classes: 3h
- Self study: 28h
Oscillations and waves

Description:


9. SUPERPOSITION OF WAVES IN ONE DIMENSION. 1. Interference. Superposition of pulses. 2. Superposition of two harmonic waves. 3. Standing wave functions. 4. Standing waves on a string fixed at both ends.


Specific objectives:
• To use harmonic functions to describe simple harmonic movement.
• To apply equations of simple harmonic motion to solving problems involving the motion of a body fixed to or pushed by a spring.
• To determine the velocity of propagation of waves.
• To use harmonic functions to describe waves propagating in a one-dimensional medium.
• To use the language associated with describing waves correctly.
• To represent graphically the one-dimensional wave function at a specific point in space or time.
• To understand the interference resulting from two one-dimensional waves travelling in the same direction with the same amplitudes, frequencies and wavelengths, in order to solve simple interference problems.
• To describe standing waves on a string fixed at both ends and solve basic problems related to this physical state.
• To qualitatively determine the intensity associated with a wave in practical cases.

Full-or-part-time: 42h
Practical classes: 15h
Self study: 27h
Electromagnetism

Description:
11. INTRODUCTION TO MATHEMATICS. 1. Scalar fields and vector fields.


15. MAGNETIC FIELDS. 1. Introduction. 2. Effect of a magnetic field on a moving charge: Lorentz force. Definition of magnetic field B. 3. Example: movement of a charged particle in a uniform magnetic field. 4. Effect of a magnetic field on an element with a current, on a loop and on a coil. Magnetic moment of a loop. 5. Effect of a magnetic field on a magnet. Magnetic moment of a magnet. Magnetic attraction and repulsion. 6. Sources of magnetic fields. Biot-Savart law. 7. Magnetic fields created by a loop, a coil, a magnet, a straight or undefined wire and a moving charge.


Specific objectives:
• To calculate the electric force between two or more charged bodies.
• To calculate the electric field and electric potential generated by various charge distributions at surrounding points.
• To describe the interaction between the electrostatic field and conductive and dielectric materials.
• To calculate the magnetic force experienced by a moving charge or by an element with a current located in an area in which there is a magnetic field.
• To understand the magnetic field generated by various distributions of electric current.
• To formally describe plane and harmonic electromagnetic waves.

Full-or-part-time: 42h
Practical classes: 15h
Self study: 27h

Laboratory session

Description:
1. Graphic representation of data. Linear regression.
2. Pressure in a fluid and measuring it.
3. Determination of the safety coefficient. 4. Spring constant.
5. Standing waves on a string.
6. 2D and 3D waves.

Specific objectives:
• To apply previously studied physical laws to specific experimental situations.
• To compare the results of measuring the same magnitude using different methods and explain possible discrepancies.
• To graphically represent the results of a measurement of two related physical magnitudes and, using the graph, determine the mathematical equation that relates them.

Full-or-part-time: 20h
Laboratory classes: 12h
Self study: 8h
# ACTIVITIES

## Activity 1

**Description:**
Attending lectures. Students work in the classroom.

**Material:**
A dossier containing summaries of each lesson in addition to the graphic materials used in class, available in the dossier or on ATENEA.

**Related competencies:**
CG11. (ENG) The ability to locate new information and interpret it in context.

**Full-or-part-time:** 20h
Practical classes: 20h

## Activity 2

**Description:**
Solving problems individually.

**Material:**
Dossier of problems with solutions and solved problems available on the ATENEA platform.

**Related competencies:**
CG11. (ENG) The ability to locate new information and interpret it in context.

**Full-or-part-time:** 60h
Self study: 60h

## Activity 3

**Description:**
In-class problem-solving session.

**Material:**
Dossier of problems with solutions and solved problems available on the ATENEA platform.

**Related competencies:**
CG11. (ENG) The ability to locate new information and interpret it in context.

**Full-or-part-time:** 25h
Practical classes: 25h
Activity 4

Description:
Preparing the practicals. Students work in groups.

Material:
Dossier of the scripts of the practicals. Dossier of class summaries and presentations. Recommended reading list.

Related competencies:
CG11. (ENG) The ability to locate new information and interpret it in context.

CT4. (ENG) Teamwork. The ability to work as a member of an interdisciplinary team, as just another member or in a leadership role, who can contribute to developing projects pragmatically and with a sense of responsibility and make commitments that take into account the resources that are available.

Full-or-part-time: 8h
Self study: 8h

Activity 5

Description:
Laboratory practicals Group work in the laboratory.

Material:
Script for the practical. Computer tools for graphic representation.

Related competencies:
CG11. (ENG) The ability to locate new information and interpret it in context.

CT4. (ENG) Teamwork. The ability to work as a member of an interdisciplinary team, as just another member or in a leadership role, who can contribute to developing projects pragmatically and with a sense of responsibility and make commitments that take into account the resources that are available.

Full-or-part-time: 12h
Laboratory classes: 12h

COVID-19 addendum

Description:
The assessment of course topics will be modified as follows.
Class 1 exercise: test questions (conceptual and numerical) + a problem, 13.5%.
Class 2 exercise: test questions (conceptual and numerical) + a problem, 13.5%.
Class 3 exercise: test questions (conceptual and numerical) + a problem, 13.5%. Problems: Classroom sessions, 4.5%.
Final exam: problems (3) + reasoning for using the strategy chosen to solve the problems, 45%.
Laboratory sessions: attendance + practical preparation + practical report, 10%.

The assessment of cross-disciplinary competency CT04 (teamwork) will be based on the activities carried out in the laboratory.
**GRADING SYSTEM**

Class 1 exercise: test questions (conceptual and numerical), 10%.
Class 2 exercise: test questions (conceptual and numerical), 10%.
Class 2 exercise: test questions (conceptual and numerical), 10%.
Problems: problem assessment sessions, 10%.
Final exam: problems (3) + reasoning for using the strategy chosen to solve the problems, 50%.
Laboratory sessions: attendance + practical preparation + practical report, 10%.

The assessment of cross-disciplinary competency CT04. Teamwork will be based on self-assessment and peer-assessment rubrics.

Students who fail the subject with a mark greater than or equal to 3 have the option to pass it by taking a resit examination. This resit examination will be conducted under the conditions established by the Academic Regulations for Bachelor’s and Master’s Degrees at the UPC (NAGRAMA) and the specific conditions established by the Terrassa School of Optics and Optometry. Students who pass the resit exam are given a final mark of 5 in the course. Otherwise, they keep the highest mark they received between the previous assessment and the resit exam.

If copying (either partial or total) is found to have taken place on any course assessment, that which is stipulated in the Academic Regulations for Bachelor’s and Master’s Degrees at the UPC will apply:

"Irregular actions potentially leading to a significant variation of the marks obtained by one or more students will be considered a breach of the assessment regulations. Such behaviour will result in a descriptive mark of "Fail" and a numerical mark of 0 for the examination in question and for the subject, without prejudice to any disciplinary proceedings that may result from that behaviour. If students disagree with this decision, they may file a complaint with the dean or director of the school. If students are not satisfied with the response, they may lodge an appeal with the rector. The total or partial reproduction of academic and research works, or their use for any other purpose, must have the express permission of the author or authors of the works. The director or dean of the school makes decisions regarding allegations about any aspects not covered in the regulations."

**EXAMINATION RULES.**

Laboratory practicals are compulsory. Students who do not attend at least 80% of sessions will not receive a mark for the course.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

**RESOURCES**

Other resources:
- Paper copies of the following dossiers are available from the printing service.
  - Summaries of each lecture and each of the presentations shown in class (these help lectures to be followed).
  - Problems (statement and solutions): to be worked on during class.
  - Script for the practical: necessary to prepare for and complete the laboratory practicals.
Intranet (ATENEA virtual campus):
- Presentations used in the classroom (they do not cover all topics).
- Collection of problems that have been completely solved from each lesson.
- Test questions by topic.
- Exams from previous years with answers.
- Notes and video explanations of each lesson.
- Useful websites:
  www.fislab.net
  http://www.sc.ehu.es/sbweb/fisica
  Physics Java Applets by C. K. Ng