Course guide
370003 - FISICA - Physics

Last modified: 19/03/2024

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: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Jesús Armengol
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Others: Jesús Armengol
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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. Describe the physical and chemical properties of the materials used in the field of 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. 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.
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

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours medium group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Mechanics

Description:
1. BASIC NOTIONS OF MECHANICS: THE LANGUAGE OF PHYSICS. 1. Fundamental principles of dynamics: Newton's laws. 2. The forces of nature. 3. Work and energy.

2. ELASTIC PROPERTIES OF MATERIALS. 1. Elastic bodies. 2. Traction and compression elasticity. 3. Uniform compression.

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:
7. OSCILLATIONS. 1. Simple harmonic motion. Equations of motion. 2. Oscillation of a mass attached to a spring. Elastic potential energy. 3. Damped oscillations.

8. DESCRIBING WAVE MOTION IN ONE DIMENSION. 1. Wave pulses. Longitudinal pulses and transverse pulses. 2. Wave functions. 3. Velocity of propagation of a pulse through a string. 4. Reflection and transmission of pulses. 5. Harmonic waves in one dimension. 6. Parameters that characterise a harmonic wave. 7. The energy and intensity of a harmonic wave. Absorption. 8. The wave equation. 9. Sound waves.

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.
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10. WAVE MOTION IN TWO AND THREE DIMENSIONS. 1. 2D waves and 3D waves. 2. Wavefront. Ray. 3. Plane, circular and spherical waves. 4. Energy propagation associated with 2D and 3D waves. Intensity. 5. The Huygens principle. Reflection, refraction and diffraction.

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.

12. THE ELECTROSTATIC FIELD. 1. Electrical load. Electrical structure of matter. 2. Coulomb's law. Units of charge. 3. The electric field. 4. Field lines. 5. Electrostatic potential energy. 6. Electric potential.

13. CONDUCTORS AND DIELECTRICS. 1. Dielectric and conductive materials. 2. Free charge, bound charge and net charge. 3. Behaviour of conductive materials subjected to an electrostatic field. 4. Behaviour of dielectric materials subjected to an electrostatic field. Dielectric polarisation. Dielectric constant.

14. DIRECT CURRENT. 1. Electric current. Movement of charges. 2. Ohm’s law. Resistance. 3. Energy balance in electric circuits: Joule effect, generators and electromotive force.

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.

16. MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES. 1. Maxwell’s equations. 2. Electromagnetic waves. Wave equation. 3. The electromagnetic spectrum. 4. Generation of electromagnetic waves.

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. Measuring distances areas and volums.
2. Mewton's second law.
3. Spring constant.
4. Standing waves on a string.
5. EM Fields 1.
6. EM Fields 2.

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

Lectures.

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. Locate new information and interpret it in context.

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

Problem solving.

Description:
Solving problems individually.

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

Related competencies :
CG11. Locate new information and interpret it in context.

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

In-class problem-solving.

Description:
In-class problem-solving session.

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

Related competencies :
CG11. Locate new information and interpret it in context.

Full-or-part-time: 25h
Practical classes: 25h

Preparing the practicals.

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. 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

Laboratory practicals.

Description:
Laboratory practicals Group work in the laboratory.

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

Related competencies :
CG11. 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

GRADING SYSTEM

Problem-solving: 40%
Basic concepts tests: 30%
Laboratory: 30 %
REASSESSMENT: The reassessment will consist of a single exam that may include questions related to theory and/or problems to solve and/or questions about laboratory sessions.

EXAMINATION RULES.

The Academic Regulations for Bachelor's and Master's Degrees at the UPC will apply.

BIBLIOGRAPHY

Basic:
- Tipler, Paul A.; Mosca, Gene. Física per a la ciència i la tecnologia [on line]. 6a ed. Barcelona: Reverté, 2010 [Consultation: 06/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5758258. ISBN 9788429144314.
- Hewitt, Paul G.; Escalona García, Héctor Javier. Física conceptual [on line]. 12ª ed. Mèxic: Pearson, 2016 [Consultation: 06/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6757. ISBN 9786073238229.
- Kane, Joseph W.; Sterheim, Morton M. Física. 2a. Barcelona: Reverté, 2000. ISBN 9788429143188.

Complementary:
- Gettys, W. Edward; Keller, Frederick J.; Skove, Malcom J. Física para ingeniería y ciencias. 2a. México: McGraw-Hill, 2005. ISBN 9789701048894.
- Cutnell, John D.; Johnson, Kenneth W. Física. 2a. México: Limusa Wiley, 2004. ISBN 9681864514.

RESOURCES

Other resources:
Paper dossiers available in the reprography service:
- Summaries of each lesson and compilation of the presentations used in the classroom (makes it easier to follow the expository classes).
- Problems (statements and solutions): they are used to work in class.
- Practice scripts: essential to prepare and carry out the practices in the laboratory.

Intranet (Atenea virtual campus):
- Presentations that are used in the classroom (they do not include the entire syllabus).
- Compilation of completely solved problems corresponding to all the lessons in the syllabus.
- Test questionnaires by topic.
- Exams from previous courses with answers.
- Notes and explanatory videos of each lesson.

Web addresses of interest:
- www.fislab.net
- http://www.sc.ehu.es/sbweb/fisica/default.htm /> - Physics Java Applets by C.K.Ng