1. OVERVIEW

Subject area	Fundamentals of Physics for Engineering
Degree	Bachelor's Degree in Computer Engineering
School/Faculty	School of Architecture, Engineering and Design
Year	First
ECTS	6
Type	Core
Language(s)	Spanish
Delivery mode	On-campus/Online
Semester	Second semester
Year	2022/2023
Coordinating professor	Daniel Gómez Vergel

2. INTRODUCTION

The subject area "Fundamentals of Physics for Engineering" forms part of the core module "Physics" of the Bachelor's Degree in Computer Engineering The main aim of this course is to guide students in acquiring a clear understanding of the various core aspects of Classical Physics: mechanics, wave motion, electromagnetism and thermodynamics. In this way, students will be able to better understand the origin, evolution and future of technology. In addition, this foundation will enable them to have a better and more in-depth understanding of the subject areas that they will later study. The aim is for students to be able to identify, model, propose and resolve situations that involve these fields of Physics and how they are used to solve engineering problems. The student will also be introduced to experimentation through carrying out laboratory work, ordering results and drawing conclusions. The course is designed to familiarise students with scientific methodology and to incorporate this methodology in their work.

3. SKILLS AND LEARNING OUTCOMES

Basic skills and general skills (CB and CG, respectively, by the acronym in Spanish):

- CG8 - Knowledge of the basic subjects and technologies, which enable the students to learn and develop new methods and technologies, as well as give them the versatility to adapt to new situations.
- CG10 - Knowledge to be able to carry out measurements, calculations, valuations, appraisals, experts' reports, studies, reports, task planning and other similar computer-related work.
- CB4 - Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

Transversal skills (CT, by the acronym in Spanish):

- CT4 – Ability to analyse and synthesise: be able to break down complex problems into manageable blocks, evaluate different alternatives and perspectives to find the ideal solution. Synthesising to reduce the complexity and better understand the situation and/or solve problems.
- CT6 - Oral or written communication: Ability to communicate and gather information, ideas, opinions and viewpoints to understand and be able to act, spoken through words or gestures or written through words and/or graphic elements.

Specific skills (CE, by the acronym in Spanish):

- CE2 - Understanding and mastery of the basic concepts of fields, waves and electromagnetism, electrical circuit theory, electronic circuits, physical principle of semiconductors and logic families, electronic and photonic devices, and how they are used to solve engineering problems.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: Describe the fundamentals of mechanics, thermodynamics and the electric and magnetic field.
- RA2: Understand the relevance of mechanics, thermodynamics and the electric and magnetic field, as well as their importance in engineering.
- RA3: Interpret the basic laws and concepts of electromagnetism and thermodynamics in biomedical use.
- RA4: Apply the mathematics involved in the physical models in the area of electromagnetism and thermodynamics.
- RA5: Employ the scientific method.
- RA6: Use scientific language.
- RA7: Demonstrate the fundamental principles of Physics by reproducing guided experiments in the laboratory.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CE2, CT4, CT6, CE2	RA1
CG8, CT4, CT6, CE2	RA2
CE2, CT4, CT6, CE2	RA3
CE2, CT4, CT6, CE2	RA4
CE2, CT4, CT6, CE2	RA5
CE2, CT4, CT6, CE2	RA6
CG10, CT4, CT6, CE2	RA7

4. CONTENTS

Unit 1: KINEMATIC AND DYNAMIC. ELECTROSTATICS IN VACUUM

The aim of this unit is to look over a number of basic concepts on particle kinematics and dynamics, especially in connection with the concepts of electric charge and its interaction with the electric field. We will study Coulomb's law and calculate the electric field in some simple situations, forming a solid starting point for more complex ones.

Contents: Coordinate systems. Physical units of measure. Particle kinematics. Newtonian mechanics. Fields and particles. Interaction between electric charges. Discrete and continuous charge distributions. Symmetry and Gauss's Law for the electric field.

Unit 2: ELECTROSTATICS IN MATERIAL MEDIA

The two aims of this unit are: (i) to study the electric field in detail by looking at its interaction with matter and (ii) to introduce the concept of power and its relation to energy. For practical use, we will devote considerable attention to the operation and limitations of an essential component in any electronic device: the capacitor.

Contents: Work and energy. Potential energy. Electrostatic potential. Conductors: lightning shielding and induction. Capacitors. Dielectrics and breakdown.

Unit 3: INTRODUCTION TO DIRECT CURRENT CIRCUITS

The aim of this unit is to introduce the student to the study of direct current electric circuits with resistors and power supplies. We will look at how to analyse them and even design them in simple cases, analysing the energy use of their different components.

Contents: Electric current. Electromotive force and dissipated power. Equivalent and transitional Laws of Kirchhoff.

Unit 4: MAGNETIC FIELD

In this unit, we will conclude the study on electromagnetism by looking at the sources of magnetic fields and the way in which they affect a circuit. We will study another fundamental component of any circuit; the coil, and we will introduce the general behaviour of alternating current circuits.

Contents: Lorentz Force Law. Symmetry and Ampère's Law. Electromagnetic induction. Self-induction and alternating current.

Unit 5: ELECTROMAGNETIC WAVES. FUNDAMENTALS OF OPTICS

The aim of this unit is to provide a theoretical basis with the fundamentals of a branch of physics that has revolutionised computer engineering: Optics. We will analyse the properties of electromagnetic waves and how they are used, with special emphasis on the transmission of information both through air and via cables and optical fibres.

Contents: Oscillatory motion and waves. Electromagnetic waves. Light and its interaction with matter.

Unit 6: INTRODUCTION TO THERMODYNAMICS

This unit introduces the basic aspects of Thermodynamics (its laws and heat transfer mechanisms), paying special attention to its relevance in Computer Science.

Contents: Thermodynamic Laws. Heat transfer mechanics.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

1. Survey on aims and interests. This survey is used to establish the aims of the subject and gather the student's interests on the subject. We will then make reference to it throughout the year for the students to evaluate the achievement of the aims and interests. In the online delivery mode, an initial questionnaire will be carried out with the same objective. Throughout the year, reference will be made to this survey, and a final reflective questionnaire will be carried out for the students to check their learning progress of the subject.

2. Lectures, subjects of study and seminars. The "lectures" taught in the on-campus delivery mode are called subjects of study and seminars in the online delivery mode, and are conducted through readings on the topic, technical notes and webinars (which are recorded for students to access). In addition,

students will be given a motivating introduction to each subject area, with multimedia presentations looking at specific topics of the subject, finally followed by forums.

3. Laboratory work: the laboratories described in section 7 [see the degree report] will mainly be used for the on-campus delivery mode, while in the online delivery mode, the virtual desktop infrastructure will be used, with the different methods and use cases explained in detail in section 7 [see the degree report].

4. a) Group investigation (*jigsaw)* and/or b) group problem-solving. This learning method will be used for the development of both declarative and procedural knowledge. In method type a), a different topic will be assigned to each group to be investigated. Later, new groups will be formed with students who have all studied a different topic, and these new groups will be proposed

comprehension and problem-solving activities. In method type b), a series of short questions and problems will be proposed to be solved in groups. To develop these methods, students have different synchronous and asynchronous tools at their disposal in the online delivery mode, such as forums and group work chats which are only accessible to members of the group, as well as *web conferences*.

8. Fieldwork, conferences, visits to companies and institutions. These will be used for the development of conditional knowledge. In the on-campus delivery mode, all learning methods may be used, while only conferences can be used in the online delivery mode, as they will be available for remote access in real time (via *streaming* technologies) or recorded and broadcast afterwards.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity (AF, by the acronym in Spanish)	Number of hours
TAF1: Lectures, reading on main topics and complementary materials, implementation of activities carried out independently and collectively (including participation in collaborative learning forums).	50 h
TAF2: Integrative group work, consisting of participation in debates and seminars, and group implementation of integrative activities, mainly in the classroom.	25 h
TAF3: Independent working.	50 h
TAF4: Tutorials, academic monitoring and assessment, both in the classroom and on the Campus Virtual.	25 h
TOTAL	**150h**

Online:

Learning activity (AF, by the acronym in Spanish)	Number of hours
TAF3: Independent working.	50 h
TAF6: Independent reading on complementary topics and materials and implementation of activities carried out independently. Subsequently, asynchronous group discussion on the Campus Virtual forum, and Webinars with the synchronous *e-learning* tools on the Campus Virtual.	50 h

TAF7: Integrative group work, consisting of participation in debates and seminars, and group implementation of integrative activities. Carried out with the support of the Campus Virtual (the debates are held via forums, the seminars are online). In addition, each group will have asynchronous communication tools to prepare the group work (mainly forums), as well as synchronous communication tools (mainly virtual meeting tools).	25 h
TAF8: Tutorials, academic monitoring and assessment through the Campus Virtual. Some assessment tests (e.g. exams) will be carried out on-campus when necessary.	25 h
TOTAL	**150h**

7. ASSESSMENT

The assessable tasks (modules) according to their delivery mode (on-campus or online) will be indicated in the tables below. The assessment criteria for each of them and their weighting with regards to the final grade of the subject area are indicated in the tables below:

On campus

Assessable task (module)	Assessment criteria	Weighting
Final Integrative Test	• Understand the relevant physical concepts and how to apply them appropriately. • Correctly use physical and mathematical tools to solve posed problems. • Organise results logically and express them accurately.	30%
Group project	• Participate actively together with the members of the group. • Demonstrate the ability to work effectively in groups. • The solution to the activity is correct and includes explanations and conclusions to facilitate reading and comprehension.	20%

Individual/group activities	• On-time delivery of the results from the activity. • Clearly present the results from the activities orally and/or in writing. • • Correctly apply the techniques of the unit to which the activity belongs. • • The solution to the problems is correct and includes explanations and conclusions to facilitate reading and comprehension.	35%
Physics Laboratory	• Actively take part in experiences. • On-time delivery of the associated reports. •	15%

In the on-campus delivery mode, the block of *individual* activities will contain interim closing activities that will be carried out on-campus, weighing 25% of the final grade of the subject area.

Online

Assessable task (module)	Assessment criteria	Weighting
Final Integrative Test	• Understand the relevant physical concepts and how to apply them appropriately. • Correctly use mathematical and physical tools for solving posed problems. • Organise results logically and express them accurately.	60%
Group project [includes Physics Laboratory]	• Actively participate in group tasks, effectively collaborating with the members of the group. • The solution to the activities is correct and includes explanations and conclusions to facilitate reading and comprehension. • Clearly present the results from the activities orally and/or in writing. • On-time delivery of the associated reports.	15%
Individual tasks	• Clearly present the results from the activities orally and/or in writing. • On-time delivery of the results from the activity. • Correctly apply the techniques of the unit to which the activity belongs. • The solution to the problems is correct and includes explanations and conclusions to facilitate reading and comprehension.	20%
Active participation	• Participation in debate forums, webinars and/or optional additional activities	5%

7.1. Ordinary exam period

In order to pass the subject area in the ordinary exam period, you must:

1. **[On-campus]** Comply with the attendance policy established by the university.

2. **[On campus and online]** Pass the subject area's final integrative test with a grade of at least 5.0 out of 10. The date, time and place of this test will be duly communicated to the students.

3. **[On-campus and online]** Achieve an average final grade of at least 5.0 out of 10 for the year.

Students who do not meet one or more of the above requirements will receive a final grade of the subject in the Ordinary Exam Period equal to:

- Its final weighted grade if it is 4.0 out of 10 or lower.
- 4 if its final weighted grade is higher than 4.0 out of 10.
- The grade in the Ordinary Exam Period will appear as NP (No grade reported) if the student has not carried out any of the assessable tasks for the subject area.

7.2. Extraordinary exam period (resits)

The students that do not pass the subject area in the Ordinary Exam Period will be able to resit the year in the Extraordinary Exam Period. This is in keeping with the Ordinary Exam Period, meaning that the same assessable activities (modules), weightings and requirements apply to both (see the previous points in section 7). However, there is no minimum attendance requirement for the on-campus delivery mode.

The student will be able to repeat the modules that were not passed, while maintaining the grades achieved in the passed modules. Details of these substitute activities will be published on the Campus Virtual at the official start of the Extraordinary Exam follow-up period.

Students who do not fulfil requirements 2 and 3 indicated in **subsection 7.1** will receive a final grade for the subject area equal to:

- The final weighted grade in the Extraordinary Exam Period if it is 4.0 out of 10 or lower.
- 4 if its final weighted grade in the Extraordinary Exam Period is higher than 4.0 out of 10.

The grade in the Extraordinary Exam Period will appear as NP (No grade reported) if the student has not carried out any of the assessable tasks for the subject area in this exam period.

8. TIMELINE

The predicted timetable for the learning units of year are as follows:

Unit	Weeks
1	1, 2 and 3
2	4, 5 and 6
3	7, 8 and 9
4	10, 11 and 12
5	13, 14 and 15
6	16 and 17
Revision and Final Integrative Test	18

This timetable may be subject to modifications for teaching and/or logistical reasons, which will be notified to the student in due time and course.

9. BIBLIOGRAPHY

The main bibliography for the subject area is as follows:

• F. W. Sears, M. W. Zemansky, H.D.Young y R.A. Freedman, "Física Universitaria", Vol. 1 y 2. Ed. Addison-Wesley Longman, 2004

• P. A. Tipler y G. Mosca, "Física para la Ciencia y la Tecnología", Vol. 1 y 2, 6ª edición. Ed. Reverté, 2010.

• M. W. Zemansky y R. H. Dittman, "Calor y Termodinámica". Mc Graw Hill, 1984.

10. DIVERSITY AWARENESS UNIT

Students with special educational needs:

To ensure equal opportunities, curricular adaptations or adjustments for students with special educational needs will be outlined by the Diversity Awareness Unit (UAD, Spanish acronym).

As an essential requirement, students with special educational needs must obtain a report about the curricular adaptations/adjustments from the Diversity Awareness Unit by contacting unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. STUDENT SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degrees and the learning process.

These surveys will be available in the survey area of your campus virtual or by email.

Your opinion is essential to improve the quality of the degree.

Many thanks for taking part.