1. OVERVIEW

Subject area	Fundamentals of Physics I
Degree	Bachelor's Degree in Physics
School/Faculty	School of Architecture, Engineering and Design
Year	First
ECTS	6 ECTS
Type	Core
Language(s)	Spanish
Delivery mode	On campus
Semester	First semester

2. INTRODUCTION

The main aim of this subject area is to provide students with a solid understanding of the theory and practice of Newtonian physics, with a special focus on the key role of the conservation principles in the formulation of classical physics. The subject area will establish the founding principles of subsequent subject areas, such as Mechanics and Electromagnetism, and of other fields of interest. We aim for students to learn to identify, model and resolve different physical situations, helping them become familiar with the scientific method by doing research-based practical activities and exercises.

3. SKILLS AND LEARNING OUTCOMES

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

- CB1. Students have shown their knowledge and understanding of a study area originating from general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.
- CG1. To understand key concepts, methods and findings in the different branches of physics while gaining a historical perspective of their development.

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

- CT4: Written communication/Oral communication: Ability to communicate and gather information, ideas, opinions and viewpoints in order to understand and be able to act upon them, whether they are through spoken word and gestures, or through written word and/or visual aids.
- CT5: Problem solving: Be able to critically evaluate information, separate complex situations into their constituent parts, recognise patterns, and consider alternatives, different approaches and perspectives in order to find optimal solutions and negotiate efficiently.

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

- CE01: To estimate orders of magnitude in order to interpret diverse phenomena.
- CE02. To describe and analyse physical systems, identifying fundamental concepts and principles to make the approximations needed to build a simplified model.
- CE03. To understand the inherent limitations of classical physics that led to the emergence of the general and special theories of relativity and quantum mechanics, resulting in solutions to new physics problems.

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

- RA1: To understand and explain in concrete terms the propagation of electromagnetic waves in a vacuum and in a homogeneous medium.
- RA2: To understand coherence theory and the superposition of fields to give a solid explanation of light interference phenomena.
- RA3: To understand scalar diffraction theory and how diffraction gratings work.

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

Skills	Learning outcomes
CT5, CE01, CE02	RA1
CB1, CG1, CT4, CT5, CE02	RA2
CG1, CT4, CT5, CE02, CE03	RA3

4. CONTENTS

1. **Background**

Brief history of physics. Magnitudes and fundamental units. Fundamentals of vector calculus. Coordinate systems.

2. **Particle kinematics**

Inertial and non-inertial frames of reference. Galilean transformations.
Rectilinear motion. Curvilinear motion. Circular motion.

3. **Particle dynamics**

Mass and momentum. Law of inertia. Conservation of momentum. Second and third laws of motion. Classical principle of relativity. Applications: motion under constant force, equilibrium and frictional forces.
Moment of force or torque. Angular momentum. Central forces.

4. **Work and energy**

Work and power. Work–kinetic energy theorem. Conservative forces, potential energy and the conservation principle in mechanical energy. Study of potential energy curves. Non-conservative forces: energy dissipation.

5. **Oscillating motion**

Simple harmonic motion. Phasors. The simple pendulum. Superposition of simple harmonic motion. Damped and forced oscillations.

6. **Wave motion**

Types of waves. Transverse waves on a string. Wave equation and superposition principle. Standing waves and normal modes. Waves in two or three dimensions. Doppler effect.

7. **Gravitation**

Newton's law of gravitation. Inertial and gravitational mass. Gravitational energy. Gravitational field and potential. Orbital motion. Introduction to Einstein's general theory of relativity: equivalence principle.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

Collaborative learning: Students learn to collaborate with other people (classmates and professors) to find creative, comprehensive and constructive solutions to questions and problems that arise from the given case studies, using all relevant knowledge and material resources available.

Problem-based learning: Students are given problems and asked to solve them, working individually or in groups.

Lectures: Presentations by the professor with the necessary technological tools to maximise comprehension of the learning content.

Guided academic activities: Individual and group work that is more independent, including information searches, written summaries, debates and the public defence of projects.

6. LEARNING ACTIVITIES

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

On campus:

Learning activity	Number of hours
Lectures	38
Oral presentations of projects and debates	6
Report writing	8
Assessment	6
Practical activities (problems, written work, projects, workshops and/or lab work)	21.5
Tutorials	16
Independent working	54.5
TOTAL	**150**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
SE1. Individual on-campus knowledge tests (theory and/or practice)	50%
SE2. Oral defence	5%

SE3. Submission of group and/or individual reports, written work, projects or exercises	30%
SE4. Performance observation	15%

On the Virtual Campus, when you open the subject area, you'll find details of your assessable tasks, including the submission dates and assessment procedures for each task.

8. BIBLIOGRAPHY

The reference work for the follow-up of this subject area is:

- H.D. Young, R.A. Freedman, F.W. Sears y M.W. Zemansky, Física universitaria, Vol. 1 y 2. 12ª ed. Pearson Education (2013).
- M. Alonso y E.J. Finn, Física. Addison-Wesley Iberoamericana (1995).
- P.A. Tipler y G. Mosca, Física para la Ciencia y la Tecnología, Vol. 1 y 2. 6ª ed. Ed. Reverté (2010).