

Course guide

240714 - 240714 - Physics I

Last modified: 13/03/2025

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018).
(Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Sempau, Josep

Others: Grossi, Claudia

TEACHING METHODOLOGY

The teaching methodology is based on four elements: (i) theory sessions, aimed at increasing the student's knowledge of the topics presented; (ii) practice sessions, devoted to provide students with problem-solving skills; (iii) laboratory sessions, oriented towards experimental and data-analysis abilities; and (iv) self-study, which involves studying without direct supervision in the classroom. This structure is intended to supply half of the knowledge, skills and competences expected from a freshman's physics course for engineers -the second half being covered in the "Physics 2" course.

During the theory sessions the fundamental concepts, together with some illustrative examples and relevant applications, will be presented. These sessions are expected to cover 20% of the total learning time.

Practice sessions will be used to learn solving numerical problems and exercises, encouraging students to actively participate with an inquiring attitude. This part is expected to cover 15% of the total learning time.

In the laboratory students will have the opportunity to gain hands-on experience about the application of the scientific method to solve practical problems. They will use experimental and data analysis techniques to take measurements, analyze the data generated and draw conclusions. The experimental work will take, including the preparatory steps in the classroom, 5% of the total learning time.

Finally, during self-study time students will be strongly encouraged to use some of these techniques: (i) read additional material suggested by the teacher, since reading from different authors with different viewpoints is a highly effective way to increase understanding of new concepts; (ii) work through practice questions to reinforce skills that are learned at the classroom; (iii) watch educational videos suggested by the teacher, or those found by students themselves, since this is a powerful way to keep students actively engaged in a concept; and (iv) discuss with your classmates about theoretical and practical aspects of the presented material.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this course is to provide basic knowledge, skills and competences in the fields of classical vectorial mechanics and, to a limited extent, of classical thermodynamics so that students are capable of using their principles and methods in a variety of applications in engineering.

STUDY LOAD

| Type | Hours | Percentage |
|-------------------|-------|------------|
| Hours large group | 52,0 | 34.67 |
| Hours small group | 8,0 | 5.33 |
| Self study | 90,0 | 60.00 |

Total learning time: 150 h

CONTENTS

1. Mathematical methods

Description:

1. The language of physics
2. Measurement and uncertainty
3. Vector algebra
4. Vector calculus

Full-or-part-time: 9h

Theory classes: 2h

Practical classes: 1h

Self study : 6h

2. Kinematics of a particle

Description:

- 1 Position, velocity, acceleration
- 2 3D motion
- 3 Relative motion
- 4 Introduction to special relativity

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

3. Dynamics of a particle

Description:

1. Introduction: Newton's Principia and the historical context.
- 2 Newton's First Law of motion
- 3 Newton's Second Law of motion
- 4 Momentum and impulse
- 5 Newton's Third Law of motion
- 6 Common forces
- 7 Angular momentum

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

4. Work and energy

Description:

- 1 Mechanical work
- 2 Kinetic energy
- 3 Potential and mechanical energy
- 4 Potential energy and stability
- 5 Trajectory solutions

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

5. Dynamics of a system of particles

Description:

- 1 Systems of particles
- 2 Internal and external forces
- 3 Center of mass
- 4 Conservation of momentum
- 5 Conservation of angular momentum
- 6 Angular momentum in the CM
- 7 Conservation of mechanical energy
- 8 Kinetic energy in the CM
- 9 Ideal constraints
- 10 Setbacks of vectorial mechanics

Full-or-part-time: 23h

Theory classes: 4h

Practical classes: 3h

Laboratory classes: 4h

Self study : 12h

6. Dynamics of a rigid body

Description:

- 1 Definition of rigid body
- 2 Kinematics of rigid bodies
- 3 Angular momentum of a rigid body
- 4 Dynamics of a rigid body
- 5 Calculation of the moment of inertia
- 6 Kinetic energy of rotation
- 7 Rolling bodies
- 8 Gyroscopic motion
- 9 Cogwheels

Full-or-part-time: 23h

Theory classes: 4h

Practical classes: 3h

Laboratory classes: 4h

Self study : 12h

7. Work, Heat and the First Law

Description:

- 1 Introduction - Definitions
- 2 Eq. of state
- 3 Zeroth Law: Temperature
- 4 Simple thermodynamic systems
- 5 Pressure. Temperature revisited
- 6 Work
- 7 Heat
- 8 First Law: Internal energy

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

8. Heat engines and the Second Law

Description:

- 1 Reversibility
- 2 Heat engines
- 3 The Second Law: entropy

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

GRADING SYSTEM

The overall course grade is calculated as:

$$\text{Grade} = \max(\text{Grade_A}, \text{Grade_B})$$

with

$$\text{Grade_A} = 0.30 \text{ Probs} + 0.30 \text{ Test} + 0.20 \text{ Lab} + 0.20 \text{ Midterm}$$

$$\text{Grade_B} = 0.40 \text{ Probs} + 0.40 \text{ Test} + 0.20 \text{ Lab}$$

where,

Grade: Final grade of the course.

Probs: Mark obtained in the problems exam.

Test : Mark obtained in the test exam.

Lab: Average mark of the laboratory reports delivered at the end of each lab session.

Midterm: Mark obtained in the midterm exam.

Students that fail the course will be given the opportunity to take a second-chance exam ("re-evaluation"). The final grade will then be:

$$\text{Grade} = 0.8 \text{ Exam2} + 0.2 \text{ Lab}$$

where

Exam2: Mark obtained in the second-chance exam.

Note that the laboratory sessions will not be repeated and, therefore, the corresponding mark in the previous formula is the same value used for the first evaluation.

EXAMINATION RULES.

To be presented in the classroom.

BIBLIOGRAPHY

Basic:

- Ling, Samuel J; Sanny, Jeff; Moebis, Bill. University physics. Houston: Rice university, 2017. ISBN 9781680920437.

Complementary:

- Alonso, M.; Finn, E. J. Fundamental university physics. 2a ed. Reading, MA [etc.]: Addison-Wesley, 1967-1968.

- Halliday, D.; Resnick, R.; Walker, J. Fundamentals of physics [on line]. 10th ed. Hoboken, NJ: John Wiley & Sons, cop. 2013
[Consultation : 29/10/2025]. Available on :
<https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3059079>. ISBN 9780470469088.