Course guide
820004 - F1FM - Physics I: Fundamentals of Mechanics

Last modified: 15/06/2026

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

Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: LUIS CARLOS PARDO SOTO - MICHELA ROMANINI

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Transversal:
2. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

TEACHING METHODOLOGY

Teaching methodology used: exposition 30%, individual work 60 %, group work 6%, guided activities 4%.

LEARNING OBJECTIVES OF THE SUBJECT

Training the student through the acquisition of a working method and providing some knowledge of the principles and basic concepts of Mechanics, so that he/she can apply them to solve problems in the engineering field.

STUDY LOAD

Type	Hours	Percentage
Hours small group	9,0	6.00
Hours large group	51,0	34.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Subject 1: Introduction

Description:
Measurement and uncertainty. Graphical analysis and linearization. Vectors.

Specific objectives:
Knowing the meaning of the dimensions of a physical magnitude. Knowing the uncertainty associated with experimental measurements and knowing how to calculate the propagation of uncertainty. Learning how to draw graphical representations of experimental data and how to make linear regressions.

Related activities:
Laboratory sessions:
all laboratory session in both terms

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 11h 12m
Theory classes: 3h 24m
Laboratory classes: 1h
Self study : 6h 48m

Subject 2: Particle kinematics

Description:
Position, displacement, velocity and acceleration vectors. Motion in one dimension. Motion in two and three dimensions. Circular motion. Simple harmonic motion. Moving frame of reference: Galileo's transformations.

Specific objectives:
Modeling the motion for a particle, determining the equations of motion from its acceleration and initial conditions. Characterizing the linear and circular motion. Knowing the crucial role of the simple harmonic motion since for its wide application in the study of diverse physical phenomena. Establishing the concept of frame of reference to understand the relative character of the movement.

Related activities:
Laboratory session:
Simple pendulum (autumn and spring term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Full-or-part-time: 21h 24m
Theory classes: 6h 48m
Practical classes: 1h
Self study : 13h 36m

Subject 3: Particle dynamics

Description:
Forces in nature. Newton's laws of motion. Linear momentum of a particle. Impulse. Force diagrams. Friction. Torque and angular momentum of a particle. Central forces.

Specific objectives:
Understanding the concepts of force and mass and knowing Newton's laws of motion. Acquiring the ability to apply the Newton's laws to solve problems that include various particles.

Related activities:
Laboratory session:
Friction (autumn and spring term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Full-or-part-time: 28h
Theory classes: 9h
Laboratory classes: 1h
Self study : 18h

Subject 4: Work, energy and power

Description:
Work. Power and mechanical efficiency. Work-Kinetic energy theorem. Kinetic energy. Conservative and non conservative forces. Potential energy. Mechanical energy. Work-energy theorem. Conservation of mechanical energy. Energy diagrams in one dimension. Criteria for stable equilibrium.

Specific objectives:
Understanding the physical concepts of work, power and energy. Identifying conservative forces and obtaining the corresponding potential energy associated with them. Problem-solving applying the work-kinetic energy theorem work and work-energy theorem. Knowing how to apply the law of conservation of mechanical energy.

Related activities:
Laboratory session:
Pulleys (fall term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 11h 12m
Theory classes: 3h 24m
Laboratory classes: 1h
Self study : 6h 48m

Subject 5: Dynamics of systems of particles

Description:
Systems of particles. Internal and external forces in a system of particles. Center of mass. Linear momentum of a system of particles. Energy of a system of particles. Collisions and explosions. Angular momentum of a system of particles. Conservation of angular momentum of a system of particles.

Specific objectives:
Describing the movement of the center of masses of systems of particles. Knowing to formulate and to apply the principles of conservation of the amount of movement and of the mechanical energy of systems of particles. Applying the theorems of conservation in the study of collisions and explosions.

Related activities:
Laboratory session:
Collisions (spring term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 2h
Self study : 16h

Subject 6: Planar rigid bodies

Description:
Statics of the rigid body. 2D kinematics of the rigid body (rotation and translation). Moment of inertia. Angular momentum of the rigid body. Dynamics of the rigid body. Work and energy in rotational and translational motion. Rolling motion. Systems of rigid bodies: angular momentum, conservation of angular momentum.

Specific objectives:
Knowing how to establish the conditions for the static equilibrium of a rigid body and solving problems of equilibrium of the rigid body. Knowing the Newton's second law for rotation and its application to solve problems. Knowing how to characterize the planar motion: coplanar translation and rotation about a fixed axis. Knowing the dynamics of the flat movement and knowing how to apply it to solve problems. Knowing and applying the angular momentum conservation in problem-solving.

Related activities:
Laboratory sessions:
Rotation (spring term)
Ballistic pendulum (fall term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 35h
Theory classes: 11h
Laboratory classes: 2h
Self study : 22h

Subject 7: Oscillations and waves

Description:
Mechanical waves. Harmonic waves. Wave equation. Energy, power and intensity of a wave. Superposition of waves: standing waves.

Specific objectives:
Identifying the condition for simple harmonic motion in terms of acceleration. Understanding the wave concepts of propagation of energy and momentum. Knowing how to describe harmonic waves. Understanding interference phenomena, in particular, standing waves.

Related activities:
Laboratory sessions:
Standing waves on strings (fall term)
Sound waves (spring term)

Related competencies :
CEB-02. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 11h 12m
Theory classes: 3h 24m
Laboratory classes: 1h
Self study : 6h 48m

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

MARK M1:
- Laboratory: 15%
- Test 1: 15%
- Test 2: 20%
- Test 3: 25%
- Problems: 25%

MARK M2:
- Laboratory: 15%
- Test 1: 0%
- Test 2: 25%
- Test 3: 30%
- Problems: 30%

MARK M3:
- Laboratory: 15%
- Test 1: 0%
- Test 2: 0%
- Test 3: 42,5%
- Problems: 42,5%

FINAL GRADE = maximum (M1 ; M2 ; M3)

THERE IS NO REASSESSMENT EXAM

EXAMINATION RULES.

Carrying out the laboratory practices and submitting all the reports are mandatory to pass the course.
In all exams, students can use a pocket calculator (without an Internet connection or AI.).
Besides, the official formula sheet, available at the Metacurs (Atenea), can be used in the Final Exam (Test 3 + Problems).
No grade review requests will be accepted once the deadline established by the course coordinators has passed.

RULES:

- No devices with Internet access or AI are allowed in the classroom (smartwatch, headphones, glasses, pen, tablet, laptop, etc.).
- The calculator must not have Internet access or AI.
- Mobile phones must be switched off and kept inside the backpack.
- The ID card must be placed on the desk so the teacher can check it.
- The teacher may assign seating in the classroom.
- Only the ID card, writing materials, and the calculator are allowed on the desk.
- Anything not needed for the exam must be left in a corner of the classroom (backpacks, bags, jackets, etc.).

BIBLIOGRAPHY

Basic:
- Tipler, Paul A.; Mosca, Gene. Física per a la ciència i la tecnologia [on line]. 6ª ed. Barcelona: Reverté, 2010 [Consultation: 26/05/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6536. ISBN 9788429144321.
- Alcaraz i Sendra, Olga; López López, José; López Solanas, Vicente. Física : problemas y ejercicios resueltos. Madrid: Pearson Educación, cop. 2006. ISBN 8420544477.
- Alarcón Jordán, Marta [et al.]. Física : problemes resolts. 3a ed. Barcelona: Edicions UPC, 2000. ISBN 8483012197.

Complementary:
- Gettys, W. E.; Keller, F. J.; Skove, M. J.. Física para ingeniería y ciencias. 2a ed. México, D.F.: McGraw-Hill, cop. 2005. ISBN 9789701048894.
- Sears, Francis W. [et al.]. Física universitària [on line]. 12ª ed. México D. F.: Pearson Educación, 2009 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1273. ISBN 9786073221252.
- Serway, Raymond A.; Jewett, John W.. Física. 3a ed. Madrid: International Thomson, cop. 2003. ISBN 8497321685.

RESOURCES

Hyperlink:
- Curso Interactivo de Física en Internet
http://www.sc.ehu.es/sbweb/fisica/default.htm />
- La baldufa: un entorn per a l'aprenentatge de la física.
http://baldufa.upc.edu/