Course guide
310606 - 310606 - Mechanics

Last modified: 09/05/2025

Unit in charge: Barcelona School of Building Construction
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Laureano Ramírez de la Piscina Millán

Others: Albert Falqués i Serra
Adrià Tauste Campo
Blas Echebarria Domínguez
Mireia Torralba Cuello

PRIOR SKILLS

Trigonometry
Elemental algebra
Vectorial calculus
Diferential calculus
Integral calculus
Elemental mechanics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Comprehension and domination of the basic concepts about the general laws of mechanincs, thermodinamics, fields, waves and electromagnetism and its application for the resolution of engineering's own 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

In the hours of presential learning, classes are alternated between expositive type and resolution of exercises and problems. In the expositive clases, in large group, the professor does a theoretical exposition to introduce basic concepts of the subject, and give examples of practical application. The resolution classes of exercises and problems are made in medium group, and alternate between the resolution of practical exercises and problems by the student with the clarification of the most complicated points by the professor. The professor also gives the student, presentially and across Atenea, exercises and problems destined to the autonomous learning. At the laboratory practices, after an introduction and explanation by the professor, the student carries out in practical groups the application of concepts seen in class, and they will have to present a report.

LEARNING OBJECTIVES OF THE SUBJECT

Comprehension and knowledge of the basic concepts about mechanical laws and its application.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	36,0	24.00
Hours large group	24,0	16.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Unit 1. Kinematics of point.

Description:
Movement of a material point. Reference systems.
Equations of movement. Trajectory.
Velocity and acceleration.
Intrinsic components of acceleration.
Types of movement.

Related activities:
Laboratory practice
Evaluation of the corresponding tests.

Full-or-part-time: 20h 25m
Theory classes: 3h 20m
Practical classes: 2h 50m
Laboratory classes: 1h
Guided activities: 0h 25m
Self study : 12h 50m

Unit 2. Solid rigid kinematics

Description:
Stiffness conditions.
Translation and rotation.
Superposition principle.
Composition of rotations.
General movement of the rigid solid.
Properties of the solid movement.
Reduction of the solid movement.
Instantaneous shaft.
Type of solid movement.
Acceleration of the solid points.

Related activities:
Evaluation of the corresponding tests.

Full-or-part-time: 22h 40m
Theory classes: 4h 50m
Practical classes: 3h 40m
Guided activities: 0h 40m
Self study : 13h 30m

Unit 3. Relative movement.

Description:
Reference systems absolut and mobile.
Relative and absolute velocity.
Relative and absolute acceleration.
Relative motion with respect to the Earth's surface.

Related activities:
Evaluation of the corresponding tests.

Full-or-part-time: 21h 35m
Theory classes: 3h 50m
Practical classes: 3h 40m
Guided activities: 0h 35m
Self study : 13h 30m

Unit 4. Particle dynamics

Description:
Newton laws. Forces.
Applications of Newton's laws.
Impulse and quantity of movement. Theorem of impulse.
Momentum of a force. Angular momentum.
Harmonic oscillator. Damped oscillator.

Related activities:
Evaluation of the corresponding tests.

Full-or-part-time: 14h 15m
Theory classes: 3h 30m
Practical classes: 1h 50m
Guided activities: 0h 25m
Self study : 8h 30m

Unit 5. Work and energy.

Description:
Work of a force.
Theorem of work - kinetic energy.
Power of a force.
Conservative and non conservative forces.
Potential energy
Conservation of mechanical energy.
Potential energy and force.
Examples of potential energy.
Equilibrium and potential energy.

Related activities:
Evaluation of the corresponding tests.

Full-or-part-time: 19h 50m
Theory classes: 3h 50m
Practical classes: 2h 40m
Guided activities: 0h 40m
Self study : 12h 40m

Unit 6. Dynamics of the particle system and of the rigid solid.

Description:
Particle system. Center of mass.
Quantity of movement of the system. Movement of the center of mass.
Theorem of impulse. Conservation of the quantity of movement.
Collisions.
Angular momento of the system. Equation of angular momentum. Conservation of the angular momentum.
Reference system of the center of mass. Angular momentum. Kinetic energy.
Rotation of a rigid solid in relation to a fixed axis. Moment of inertia.
Dynamic equation of rotation. Kinetic energy of rotation.
Extensive bodies: mass center and moment of inertia. Steiner theorem.
Gyroscope.

Related activities:
Laboratory practice.
Learning experience.
Evaluation of the corresponding test.

Full-or-part-time: 30h
Theory classes: 6h 50m
Practical classes: 5h 10m
Laboratory classes: 1h
Guided activities: 0h 40m
Self study : 16h 20m

Unit 7. Gravitation

Description:
Movement of the stars. Kepler laws
Universal gravitational law. Gravitational field.
Gravitational potential energy.
Distributions of mass with spherical symmetry.
Circular orbit.
Eliptic orbit.

Related activities:
Evaluation of the corresponding tests.

Full-or-part-time: 19h 45m
Theory classes: 3h 50m
Practical classes: 2h 40m
Guided activities: 0h 35m
Self study : 12h 40m

ACTIVITIES

PRACTICE 1- TORSION PENDULUM

Description:
Study of the dynamics in a torsion pendulum, with the measurements of its period.

Specific objectives:
Calculation of inertia momentum, calculation of elastic characteristics, calculation of errors

Material:
Torsión pendulum, stopwatch

Delivery:
Report

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

PRACTICE 2 - MOVEMENT OF A BODY UNDER THE ACTION OF THE GRAVITY FORCE

Description:
Study of the kinematics of a falling body and parabolic motion.

Specific objectives:
Measurement of positions, velocities and accelerations of a body under the action of the gravitational force.

Material:
Body, webcam, computer, software of image captation, software of image analysis, software of data processing

Delivery:
Report

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

CHAIR EXPERIENCE - GYROSCOPE

Description:
Study of the dynamics of a gyroscope

Specific objectives:
Application of concepts of rigid solid dynamics.

Material:
Gyroscope

Full-or-part-time: 3h 20m
Laboratory classes: 2h
Self study: 1h 20m

MIDTERM EXAM OF THEORY

Description:
Theory exam corresponding to units 1-3

Specific objectives:
Evaluation of theoretical questions of the subject

Full-or-part-time: 0h 45m
Guided activities: 0h 45m

MIDTERM PROBLEM EXAM

Description:
Problem exam corresponding to units 1-3

Specific objectives:
Evaluation of the practical aspects and applications of the subject

Full-or-part-time: 2h
Guided activities: 2h

FINAL THEORY EXAM

Description:
Theory exam corresponding to the whole course.

Specific objectives:
Evaluation of theoretical questions of the subject

Full-or-part-time: 0h 45m
Guided activities: 0h 45m

FINAL PROBLEM EXAM

Description:
Final exam of problems corresponding to the whole course

Specific objectives:
Evaluation of the practical aspects and application of the subject

Full-or-part-time: 2h 30m
Theory classes: 2h 30m

GRADING SYSTEM

There are two practices, two midterm exams, a theoretical exam of all the content of the subject and a final exam. Small evaluable exercises are performed in the classroom
CL:
- During the course there are two midterm exams that include the first part of the subject. In the first midterm PT, carried out during week 7, the theoretical aspects of the subject will be evaluated and will count 10% towards the final mark. In the second midterm PP, carried out in week 8, the practical and application aspects will be evaluated, and will contribute 20% towards the final mark. The student will have the option to recover the two midterm exams in a single exam at the end of the course RP, that will count 30% towards the final mark.
- There will be a theoretical exam of all the contents of the subject during the week 15 FT. In this exam the theoretical aspects will be evaluated, and will contribute with a 20% of the final mark.
- At the final exam of the subject FP will be evaluated practical aspects and application of the subject, and will contribute with a 40% to the final mark.
- The qualification of practices PR is calculated by the arithmetic average of each practice, and contributes 10% towards the final mark.
- The formula for the final grade calculation is:
GRADE=0.1*CL+0.2*FT+0.1*PR+0.4*FP + MAX{0.1*PT+0.2*PP ; 0.3*RP}
- The evaluation of the generic competence 05 TEQ N1 "Work in group-Level1" will be carried out in the practice laboratory and with the elaboration of the practice reports.

Attendance and classwork will be valued.

The students that have obtained a qualification between 3.5 and 4.9 will have the option of showing up to one reevaluation exam of the whole subject. This test will consist in an exam that will evaluate theoretical, practical and application to the whole content of the subject. In case of passing this exam, the final mark will be 5. This test cannot be used in order to increase the mark if the subject is already passed.

EXAMINATION RULES.

The delivery of the final exam removes the possibility of having a "not atended".
The delivery of the reevaluation midterm exams replaces the qualification of the same ones for the new qualification in all effects.
To do the reevaluation test it is necessary to have a final mark between 3.5 and 4.9. In case of passing this exam, the final mark will be 5.

BIBLIOGRAPHY

Basic:
- Burbano, S.; Burbano, E.; Gracia, C. Física general. 32a ed. Madrid: Tébar, 2003. ISBN 8495447827.
- Burbano, S.; Burbano, E.; Gracia, C. Problemas de física general. 26a ed. Zaragoza: Mira, 1994. ISBN 848868861X.
- Alonso, M.; Finn, E.J. Física. Ed. revisada y aumentada. México: Addison Wesley Longman, 1998.
- Martínez Benjamín, Juan José. Mecánica newtoniana [on line]. Barcelona: Edicions UPC, 2001 [Consultation: 12/02/2025]. Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/18e7aks/alma991002286999706711. ISBN 8483014351.

Complementary:
- Tipler, P.A.; Mosca, G. Física para la ciencia y la tecnología, vol I, mecánica, oscilaciones y ondas, termodinámica. 5a ed. Barcelona: Reverté, 2005. ISBN 9788429144116.
- Sears, F.W. ; Zemansky, M.W. ; Young, H.D. Física universitaria. 11a ed. México: Pearson Educación, 2004.