Course guide
300503 - FIS-S - Physics

Last modified: 05/07/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN SATELLITE ENGINEERING (Syllabus 2024). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

Operability with the fundamentals of trigonometry, vector calculus, differential and integral calculus.
Familiarity with the concepts of physical quantity, unit and unit conversion.
Familiarity with the use of scientific notation in basic calculus.
Operability with the basics of kinematics in one and two dimensions.
Familiarity with the concepts of force, work, energy and field.

REQUIREMENTS

Post-compulsory secondary education mathematics and physics.

TEACHING METHODOLOGY

This is a subject where, in addition to introducing and consolidating physics concepts that an engineer must know, the aim is to develop their ability to solve problems that involve relating different concepts and reasoning using equations and mathematical calculations, to make predictions in different situations. This ability must be developed and assessed individually, but the advantages of teamwork will also be used, so that students are able to defend their proposed solutions to problems and cooperate with their colleagues. The Theory Group classes will mainly follow the expository model, where the teacher will introduce the basic concepts and laws of physics. The problem classes will allow to consolidate the knowledge of these concepts and laws and use them to solve problems. These problems will be proposed to be solved by the students themselves at home and by teachers and students later in class. In the laboratory classes, several experiments will be carried out to consolidate theoretical learning. Finally, autonomous learning will be guided by a collection of problems that students will have to solve individually at home for later discussion during problem classes. The Atenea Digital Campus will be used regularly for the exchange of documentation between students and teachers and to keep the evaluation process up to date. Texts and videos related to the studied concepts and a problem collection will be introduced to guide students' independent learning.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the subject of Physics the student must be able to:

Define the fundamental concepts of mechanics and electromagnetism.

Understand the relationship between position, velocity and acceleration, explain the meaning and implications of Newton's laws, the principle of conservation of energy, the centre of mass, linear momentum, the moment of a force, the moment of inertia, angular momentum, simple harmonic motion, Coulomb's law, the concept of electric field, Gauss's law, the concepts of electric potential and electrostatic potential energy, the concept of current and Ohm's law, the concepts of magnetic field and magnetic force, Biott and Savart's law, Ampère's Law and Faraday-Lenz's Law. These concepts will be introduced mainly in theory class, but also in laboratory practices.

Identify the magnitudes, principles and physical laws that allow modelling and understanding of real situations and reach quantitative conclusions and consequences about them.

Apply the concepts and physical laws acquired and the mathematical tools necessary to solve problems of a certain level of complexity in mechanics and electromagnetism and interpret the results obtained.

Communicate clearly and effectively in writing to justify scientific reasoning with qualitative and quantitative arguments.

Acquire knowledge independently, using the information sources and guidelines indicated and identifying learning gaps.

Learning Outcomes

Knowledge
K1. Identify the tools of physics applied in the field of satellite engineering.
Skills
S1. Apply the concepts of basic physics and mechanics to problems related to space engineering.
Competences
C1. Develop the learning skills necessary to tackle other subjects more independently.

CONTENTS

KINEMATICS

Description:
Theoretical concepts: Position, speed and acceleration. Kinematics in 2 dimensions. Normal and tangential acceleration. Kinematics of circular motion.

Specific objectives:
Examples and applications: Movement in 1 dimension with constant and non-constant acceleration. parabolic shot.

Related activities:
AV1: Theory test.
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 12h 30m
Theory classes: 5h 30m
Self study : 7h

DYNAMICS

Description:
Theoretical concepts: force, mass, reference systems and Newton's laws. Central forces: gravity and weight, electrostatic force and elastic force (simple harmonic motion). Contact forces, tensions, friction and centripetal force.

Specific objectives:
Examples and applications: Massless pulleys, inclined planes, curvilinear trajectories, forces between charges.

Related activities:
AV1: Theory test.
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 26h
Theory classes: 11h
Self study : 15h

WORK AND ENERGY

Description:
Theoretical concepts: Work by constant and variable force in position. Kinetic energy Work-Kinetic Energy Theorem. Conservative forces and potential energy: gravitational, elastic and electric potential energy. Differential relationship between force and potential energy. Theorem of conservation of mechanical energy.

Specific objectives:
Examples and applications: Massless pulleys, inclined planes, vertical loop, discrete charge distributions.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.
AV5: Mechanics laboratory activity report.

Full-or-part-time: 20h 30m
Theory classes: 7h 30m
Laboratory classes: 2h
Self study : 11h

SYSTEMS OF PARTICLES

Description:
Theoretical concepts: Center of mass. Linear momentum conservation theorem. A moment of a force. Scalar moment of inertia. Angular momentum Angular momentum conservation.

Specific objectives:
Examples and applications: Calculation of centres of mass and moment of inertia for discrete distributions.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 16h
Theory classes: 7h
Self study : 9h

ELECTRIC FIELD

Description:
Theoretical concepts: Electric field concept. Electric field calculation for discrete and continuous charge distributions. Electric field flux. Gauss's law.

Specific objectives:
Examples and applications: Movement of charges in the presence of electric fields. Electric field of the dipole. Calculation by Gauss's Law of the electric field in problems with spherical, cylindrical and planar symmetry.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 19h 30m
Theory classes: 8h 30m
Self study : 11h

ELECTRICAL POTENTIAL

Description:
Theoretical concepts: Electric potential and potential difference. Calculation of the electric potential for discrete and continuous distributions. Relationship between electric field and electric potential. Conductors and current. Ohm's law. Capacitors, capacity and stored energy.

Specific objectives:
Examples and applications: Calculation of the potential from the electric field with path integrals. Conductors in electrostatic equilibrium and shielding. Capacitance of parallel plate capacitor and cylindrical and spherical capacitor. Dielectric effects in capacitors, dielectric constant.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 22h
Theory classes: 9h
Self study : 13h

MAGNETIC FIELD

Description:
Theoretical concepts: Magnets. Lorentz force. Forces and moments on closed circuits. Magnetic dipole moment. Law of Biot and Savart. Magnetic field created by a current wire, by a current loop and by a coil. Forces between current elements. Ampère's law.

Specific objectives:
Examples and applications: Movement of charges and current loops in the presence of magnetic fields. Integration calculation of the magnetic field generated by a loop. Calculation with Ampère's law of the magnetic field of the infinite wire, the coil and the toroid.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.

Full-or-part-time: 22h 30m
Theory classes: 9h 30m
Self study : 13h

MAGNETIC INDUCTION

Description:
Theoretical concepts: Magnetic field flux and Gauss's law for magnetism. Generalised electromotive force. Magnetic induction. Faraday's law. Lenz's law. Self-induction and coefficient of self-induction. General structure of an RLC circuit.

Specific objectives:
Examples and applications: Induced electromotive force and motion. Movements of a magnet on a circuit. Generators and alternating current. Coefficient of self-induction in coils.

Related activities:
AV2: Mid-term exam.
AV3: End of semester exam.
AV4: Problem solving of the collection outside the classroom by the student. Group discussion on the methods used and the results obtained.
AV5: Electromagnetism laboratory activity report.

Full-or-part-time: 11h
Theory classes: 4h
Laboratory classes: 2h
Self study : 5h

ACTIVITIES

(AV1): Theory and problems test

Description:
During the first six weeks, an individual test will take place on theory and problems of the mechanics content studied during the course.

Specific objectives:
Check the knowledge gained about the content studied in the practices. Develop the ability to communicate clearly and effectively in writing.

Material:
The test, paper, calculator.

Delivery:
The test will be delivered individually to be evaluated.

Full-or-part-time: 10h
Self study: 10h

(AV2): Mid-term exam

Description:
During the mid-semester exam week, an individual exam will take place on theory and problems of the mechanics content studied during the course.

Specific objectives:
Check the knowledge achieved on the studied contents. Develop the ability to communicate clearly and effectively in writing, justifying the resolution of problems and answering theoretical questions.

Material:
The exam, paper, calculator.

Delivery:
The exam will be delivered individually to be evaluated.

Full-or-part-time: 10h
Self study: 10h

(AV3): End of term exam

Description:
During the end-of-semester exam week, an individual exam will take place on theory and problems of the mechanics and electromagnetic content studied during the course.

Specific objectives:
Check the knowledge achieved on the studied contents. Develop the ability to communicate clearly and effectively in writing, justifying the resolution of problems and answering theoretical questions.

Material:
The exam, paper, calculator.

Delivery:
The exam will be delivered individually to be evaluated.

Full-or-part-time: 10h
Self study: 10h

(AV4): Problem solving activities

Description:
In these sessions, problems from the collection of the corresponding topic will be worked on, which the students will have previously solved at home. Some of the problems will be presented on the blackboard by the teachers and/or students. The methods used and the results obtained will be discussed collectively. Eventually, the teacher may order deliverables, which the students will have to solve outside the classroom individually or in small groups.

Specific objectives:
Consolidate the knowledge acquired in theory classes. Develop problem-solving skills. Autonomously acquire the required knowledge to be able to solve collection problems at home.

Material:
Collection with the proposed problems, calculator.

Delivery:
The set of deliverables ordered during all sessions and/or problem solving.

Full-or-part-time: 66h
Self study: 43h
Theory classes: 23h

(AV5): Lab reports

Description:
A report will be made in English presenting the results obtained in the mechanics and electromagnetism laboratory sessions. Independent learning will take place prior to practice. A guide with the associated theory will be distributed before each practice.

Specific objectives:
Check the knowledge gained about the content studied in the practices. Develop the ability to communicate clearly and effectively in writing.

Material:
Summary of the practices and instructions for submitting reports.

Delivery:
Delivery of the report to be evaluated. The report will be delivered before the week of final exams.

Full-or-part-time: 10h
Self study: 6h
Laboratory classes: 4h

GRADING SYSTEM

Defined on the subject's infoweb.

EXAMINATION RULES.

All proposed activities are mandatory. An exam, control, exercise or project not submitted will be scored with a grade of zero. Exams/tests will be held individually.

BIBLIOGRAPHY

Basic:
- Walker, Jearl; Resnick, Robert; Halliday, David.. Fundamentals of physics.. ISBN ISBN 9780471758013..
- Tipler, Paul Allen; Mosca, Gene.. Física para la ciencia y la tecnología.. ISBN ISBN 8429144102.

RESOURCES

Other resources:
IT Material: Specific web pages that will be accessed from the subject's Atenea web page.