Physics

Academic Year: (2024 / 2025) **Review date: 25-04-2024**

Department assigned to the subject: Physics Department

Coordinating teacher: CASTRO BERNAL, MARIA VANESSA DE

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics and Mathematics at Spanish high school level (recommended)

SKILLS AND LEARNING OUTCOMES

¿ Understand the concepts of mechanics and dynamics of particle .
¿ Apply the concepts of electrostatics to electric current and semiconductors.
¿ Understand electronic physics and its application to semiconductor devices.

OBJECTIVES

Basic and general skills

CB1 Students should demonstrate that they possess knowledge in an area of ¿¿study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study

CGB2 Understanding and mastery of the basic concepts of fields and waves and electromagnetism, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, and their application to solve engineering problems.

CB3 Students should have the ability to gather and interpret relevant data (normally within their area of ¿¿study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature.

Learning outcomes

RA1.1 Knowledge and understanding of mathematics and other basic sciences inherent to their engineering specialty, at a level that allows to acquire the rest of the skills of the Degree
- To understand and handle basic concepts of electromagnetism, electrical circuits and semiconductor devices
- To understand the mathematical models that explain these phenomena.
- Ability to expand and develop concepts acquired in previous educational stages, with focus on understanding the physical principles that underlie technological applications in today's world.
- To understand and use the scientific method.
- To understand and use scientific language.
- To develop reasoning techniques and strategies for problem solving.

RA6.1 Ability to collect and interpret data and handle complex concepts within their specialty, to make judgments that involve reflection on ethical issues.
- To handle measurement devices and systems in an elementary way.
- To interpret and analyze experimental data.
- Ability to organize, analyze and interpret information, including the ability to make critical judgments based on said information.
- Ability to search and analyze information from different sources

- Ability to work as part of a group.

DESCRIPTION OF CONTENTS: PROGRAMME

1. A review of cinematics and dynamics.
Kinematics: Uniform motion and motion with uniform acceleration.
Dynamics: Newton¿s laws
Work.
Kinetic energy and the Work-Energy theorem.
Potential energy and conservative forces.
Fundamental interactions

2. Atoms and solids.
Electric charge.
The atomic structure of matter. The electron. The atomic nucleus: protons and neutrons.
The Bohr model. The electron energy levels.
Revised atomic models. Quantum numbers. The Pauli exclusion principle.
Solids. Ionic, covalent and metallic bonds.
Energy levels in solids. The conduction and valence bands.
Insulators, conductors and semiconductors.
Charge carriers in semiconductors: electrons and holes
Intrinsic and extrinsic semiconductors

3. Coulomb's law. Electric field.
Interaction between two electric charges. Coulomb's law.
Electric field due to a point charge. The superposition principle.
Electric field lines.
4. Gauss' law.
Uniformly charged distributions and charge densities.
Electric flux.
Gauss' law.
Gauss's law as a tool for the calculation of electric fields.

5. Electric potential.
Electrostatic work.
Potential difference between two points. Electric potential.
Potential due to a point charge. The superposition principle.
Electrostatic energy. Conservation of energy.

6. Conductors.
Conductors and insulators. Conductors in electrostatic equilibrium.
Properties of conductors in electrostatic equilibrium: Electric field and potential inside the conductor. Charge distributions. Electric field and potential at the surface.
Conductors and cavities. Electric shielding.

7. Capacitors and dielectrics
Capacitor.
Definition of capacitance. Capacitance of a parallel plate capacitor.
Parallel and serial capacitors.
Energy stored in a capacitor.
Capacitors with dielectrics. Dielectric constant. Dielectric breakdown.

8. Electric current and electric circuits.
Electric current. Intensity and current density.
Ohm's law. Resistance. Electrical conductivity.

9. Magnetic forces and magnetic fields.
Introduction to the magnetism.
Magnetic field. The Lorentz force on a point charge.
Charged particles moving inside a magnetic field.
Magnetic forces on a current-carrying wire. Magnetic torques. Magnetic moment of a coil.
Magnetic fields due to currents.

Ampère¿s law.

10. Semiconductor devices.
The pn junction. Semiconductor diodes. Characteristic curve.
Applications: Optoelectronic devices: LED, laser diode, photodiode.oField effect transistors.
Field Effect Transistors: the MOSFET transistor.
Applications: description of logical gates; memory cells.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures where the theoretical concepts are explained (2.2 ECTS)

- Sessions in smaller groups to solve problems (2.5 ECTS)

The main skills to be developed in these activities are
- To understand the statement of the problem (for instance drawing an scheme that summarizes the statement)
- To identify the physical phenomenon involved in the statement and the physical laws related to it.
- To develop a strategy to reach the objective (for instance breaking the problem in small subproblems).
- To be careful in the use of mathematics
- To analyze the reasonability of the result (is the final number reasonable?, are the dimensions consistent?)

- Laboratoy sessions. (0.7 ECTS)
In this academic year half of the laboratory sessions will be carried out synchronously online.
The main skills to be developed in this activity are:
- To understand that physics is an experimental science and they can reproduce the laws that have been theoretically explained in the lectures.
- To use scientific instruments and to be careful in its operation
- To be careful in the acquisiton of the experimental data.
- To learn the basis of the management of a scientific data set
- To write a report with the main results of the experiment
- To reason in a critical way these results: have we achieve the goals of the experiment?

- Final exam (0.6 ECTS)

- Tutorial sessions: 1 session of 1 h per week (aggregate group) and 1 session of 1h per week (small group)

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

- Laboratory sessions (15% of final mark)

Attending the laboratory session and handing-in the reports is compulsory

- Short individual exams (25% of final mark)

- Written exam (60% of final mark)

This exam is made at the end of the semester and it is the same for all the students. A minimum mark of 3.0 out of 10 will be required.

Contents:
- Problems to be solved covering the topics of the program.
- Short theoretical questions.

BASIC BIBLIOGRAPHY

- Serway, Raymond A. Physics for scientists and engineers , Brooks/Cole Cengage Learning.

- Tipler, Paul Allen Physics for scientists and engineers : with modern physics , W.H. Freeman,.