

## Physics

Academic Year: ( 2021 / 2022 )

Review date: 01-07-2021

Department assigned to the subject: Physics Department

Coordinating teacher: CASTRO GONZALEZ, ANTONIO JESUS 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 high school level (bachillerato)

## OBJECTIVES

Basic and general skills

CB1 Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

CGB2 Understand and master the basic concepts of fields, waves and electromagnetism, electrical circuit theory, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, and their application to typical engineering problems.

CB3 The students must have the ability to collect and interpret relevant data (usually 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 comprehension of mathematics and other basic sciences inherent in their engineering speciality, allowing them to achieve the other competences of the degree

- Ability to understand and know basic concepts of electromagnetism, electric circuits and semiconductor devices.
- Ability to understand and use the mathematics involved in the physical models
- Ability to expand and develop concepts previously acquired in earlier educational stages and capability to use them in the comprehension of the physical principles underlying technological applications in the real world.
- Ability to understand and use the scientific method
- Ability to understand and use the scientific language
- Ability to develop skills to solve problems

RA6.1 Ability to collect and interpret data and handle complex concepts within their specialty, to make judgments that involve reflection on ethical issues

- Ability to use scientific instruments and analyze experimental data.
- Ability to retrieve and critically analyze information from different sources
- Ability to work in a team.

## 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. Field 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)

The lecturer will provide a file with the following information (1 week in advance)

- Main topics to be discussed during the session  
- Chapters/sections in each of the text books provided in the bibliography where the student can read about these topics

- Sessions in small 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?)
- Small works focused to the search of scientific information in different sources (mainly internet).

- Laboratory 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 acquisition 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)

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## ASSESSMENT SYSTEM

- Laboratory sessions (15% of final mark)

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

Evaluation of the reports. The mark is shared by the members of the group.

- Activities in groups (25% of final mark)

Attendance.

Short exams.

Delivery and evaluation of the proposed activities

- 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.

**% end-of-term-examination:** 60

**% of continuous assessment (assignments, laboratory, practicals...):** 40

## 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,.