Physics

Academic Year: (2019 / 2020) **Review date: 29-04-2019**

Department assigned to the subject: Physics Department

Coordinating teacher: SANTALLA ARRIBAS, SILVIA NOEMI

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

The goal of this course is that the student can understand the physical phenomena involved in the operation of components and peripherals of a computer.

In order to achieve this goal, the following competences and skills have to be acquired (CB1, CB3, CGB2) (PO: a,b d)

- 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
- Ability to use scientific instruments and analyze experimental data.
- Ability to retrieve and analyse 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.
Optoelectronic devices: LED, laser diode, photodiode.
Bipolar transistors. Transistor as an amplifier or switch.
Field effect transistors. The MOSFET transistor.
Applications: description of logical gates; memory cells.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures where the theoretical concepts are explained (PO: a)

The lecturer wil 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 were the studend can read about these topics

- Activities in groups (~40 students dividen in 2-3 people groups) to solve problems (PO: a, d).

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). (PO: a,d)

- Laboratoy sessions (~24 students dividen in 2 people groups). (PO:b, d)

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?

ASSESSMENT SYSTEM

- Laboratory sessions (15% of final mark) (CB3) (PO: b, d)
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) (CB1, CB3, CGB2) (PO: a, d)

Attendance.
Short test exams.
Delivery and evaluation of the proposed activities

- Written exam (60% of final mark) (CGB2) (PO: a)

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 (over 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 (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- JEWETT, JW & SERWAY, RA Physics for scientists and engineers, Cengage Learning.
- TIPLER, PA & MOSCA, G Physics for scientists and engineers , Freeman.