Physics III

Academic Year: (2019 / 2020) **Review date: 10/07/2020 09:03:35**

Department assigned to the subject: Physics Department

Coordinating teacher: TRIBALDOS MACIA, VICTOR

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I,
Calculus I and II

OBJECTIVES

This course should make the student familiar with the basics concepts of electromagnetism and wave optics. The goal of this course is that the student develop abilities in understanding abstract physical concepts through the combination of lectures, experiments and problem solving with the aid of mathematical tools.

In order to achieve this goal, the following competences and skills have to be acquired:

- Ability to understand and use the mathematics involved in the physical models.
- 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. Presentation of the Course, Electric Charges and Electric Forces
   - Electric Charge.
   - Coulomb´s Law.
   - Dimensions and Units.
   - The Superposition Principle.
2 - The Electric Field.
   - Definition of Electric Fields.
   - Electric Field Created by a Point Charge.
   - The Superposition Principle.
   - The Electric Field Lines.
   - Electric Fields of general Charge Distributions.
3 - The Electric Flux and Gauss' Law.
   - Flux of a vector Field.
   - The Electric Flux.
   - Gauss' Law.
   - Use of Gauss' Law to calculate the Electric Field.
4. Electrostatic Potential Energy.
   - Gravitational Potential Energy.
   - Electrostatic Potential Energy.
   - Energy Conservation.
   - Electrostatic Potential.
   - Electric Potential Difference.

- Equipotential surfaces and lines

5. Electrostatic Potential (cont.)
   - Electrostatic Potential of General Charge Distributions.
   - Potential of a System of Charges.
   - Relation between Electrostatic Potential en Electric Field.
   - Electrostatic Energy of a System of Charges.
   - Electric Conductors in Equilibrium.
   - Conductors in Electrostatic Equilibrium.
   - Matter Aggregations.
6. Capacitance and dielectrics.
   - Capacitance.
   - Parallel Plane, Cylindrical and spherical Capacitors.
   - Capacitors in circuits.
   - Dielectrics. Electric Properties of Matter.
   - Energy stored in Capacitors.
   - Energy Density of the Electrical Field.
7. Current and Resistance.
   - Current density and current intensity.
   - Ohm's law.
   - Resistance and conductivity.
   - Joule's Law.
   - Energy and Power in Electric Circuits.
   - Electromotive Force.
8. Magnetic Fields.
   - Magnetic Field.
   - Lorentz's Force on a Charged Particle.
   - Magnetic Force on a Current-Carrying Wire.
   - Torque on a Current-Carrying Loop.
   - Magnetic Moment.
9. Sources of Magnetic Fields.
   - Sources of the Magnetic Field.
   - Biot-Savart's Law.
   - Forces Between Current-Carrying Conductors.
   - Magnetic Flux.
   - Ampère´s Law.
   - Application of Ampère's Law to Calculate Magnetic Fields.
   - Magnetic Properties of Matter.
10. Electromagnetic Induction.
    - Faraday´s Law of Induction.
    - Motional Electromotive Force.
    - Lenz´s Law.
    - Electromagnetic Induction.
    - Self-Inductance ad Mutual Induction.
    - Energy and Energy Density of a Magnetic Field.
11. Electromagnetic Waves.
    - Displacement Current.
    - Maxwell´s Equations.
    - Wave Solutions to Maxwell´s Equations.
    - The Speed of Light.
    - The Electromagnetic spectrum.
    - Traveling waves.
    - Poynting Vector.
12. Properties of Light.
    - Propagation of Light.
    - Reflexion, Refraction and Absorption.
    - Interference. Double Slit Experiment.
    - Diffraction. Double Slit Interference.
    - Circular Aperture. Diffraction Limits.

LEARNING ACTIVITIES AND METHODOLOGY

- LECTURES: Sessions where the theoretical concepts are explained. (80 students, 100 minutes per week)

The lecturer will provide a file with the following information (few days in advance)
- Main topics to be discussed during the session
- Chapters/sections in each of the text books provided in the bibliography were the student can read about these topics

- RECITATIONS: Sessions where proposed problems and activities are discussed. (40 students, 100 minutes per week)

The lecturer will provide a file with problems (few days in advance)

The main skills to be acquired in recitation sessions are:
- To understand the statement of a problem
- To identify the physical phenomenon involved in the statement and the physical laws involved
- To develop an strategy to reach the objective
- To be careful in the use of mathematics
- To be able to make a critical analysis of the results

- LABORATORY: Sessions dedicated to perform and analyze experiments (~20 students divided in 2 people groups, Four 100 minutes sessions)

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 experimental data
- To learn the basis for the management of a scientific data set
- To be able to write a report with the main results of the experiment
- To be able to discuss in a critical way the experimental results.

Every week there will be one hour of tutoring available to students.

ASSESSMENT SYSTEM

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

1) Laboratory sessions (15% of final mark). Evaluation based on:

- Attendance to the laboratory sessions, participation and attitude. Activities in groups of two students.
- Laboratory reports quality. Mark is shared by the members of the group.

2) Assessment during the course (25% of final mark). Evaluation based on:

- Attendance.
- Midterm exams and perhaps
- Delivery and evaluation of assigned homework.

3) Final exam (60% of final mark).

The exam is made at the end of the semester and it is the same for all the students
Contents:

- Problems to be solved covering the topics of the program and perhaps
- Short theoretical questions.

Despite the final mark is obtained with the indicated percentages, to pass the course it is COMPULSORY:

- The attendance and the report presentation to the four laboratory sessions,
- To obtain at least a score of 3 out of 10 in the final exam.

BASIC BIBLIOGRAPHY

- Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson. College Physics Fourth Edition. ISBN 978-0-07-131794-8. , McGraw Hill, 2010

- Tipler PA, Mosca G Physics for Scientists and Engineers, Volume 2, 6th Edition., ISBN-10:0716789647, ISBN-13: 978-0716789642. 2007, W.H. Freeman, 2007

ADDITIONAL BIBLIOGRAPHY

- J.R. Reitz, F.J. Milford, R.W. Christy Foundations of Electromagnetic Theory ISBN-10: 0321581741, Ed. Addison Wesley, 2008

- R.K. Wangsness. Electromagnetic Fields. ISBN-10: 0471811866 ISBN-13: 978-0471811862., Wiley, 1986