Physics III

Academic Year: (2023 / 2024) **Review date: 19/12/2023 13:25:18**

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,
Linear Algebra

LEARNING OUTCOMES

RA1: Acquire knowledge and understanding of the basic general fundamentals of engineering and biomedical sciences.
RA2: Be able to solve basic engineering and biomedical science problems through a process of analysis, identifying the problem, establishing different methods of resolution, selecting the most appropriate one and its correct implementation.
CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1: Adequate knowledge and skills to analyse and synthesise basic problems related to engineering and biomedical sciences, solve them and communicate them efficiently.
CG3: Knowledge of basic scientific and technical subjects that enables them to learn new methods and technologies, as well as providing them with great versatility to adapt to new situations.
CG4: Ability to solve problems with initiative, decision-making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the biomedical engineer's activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG8: Ability to solve mathematical, physical, chemical and biochemical problems that may arise in biomedical engineering.
CG12: Ability to solve mathematically formulated problems applied to biology, physics and chemistry, using numerical algorithms and computational techniques.
ECRT2: Ability to solve physical problems that may arise in engineering and biomedicine. Ability to apply knowledge of: kinematics; dynamics; electromagnetism; waves; small oscillations; thermodynamics.
CT1: Ability to communicate knowledge orally and in writing to both specialised and non-specialised audiences.

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 to:

- Use the scientific method.
- Employ the scientific language.
- Understand and use the mathematics involved in the physical models.
- Solve problems.
- Use scientific instruments and analyze experimental data.
- Find, compare and analyze information from different sources.
- 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.
   - Breakdown Electric field
   - 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.
   - Kirchoff's Rules.
8. Magnetic Fields.
   - Magnetic Field.
   - Magnetic Field Lines.
   - Magnetic Flux.
   - 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.
   - 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: Weekly sessions of 100 minutes, divided in two 50 minutes parts with a break, where the theoretical concepts are explained. A few days in advance files will be provided in the subject webpage with the following information:

  - Main topics to be discussed during the session.
  - The presentation that will be used during the session.
  - Notes with recommended material were students can supplement the concepts discussed during the lecture.

- RECITATIONS: Weekly sessions of 100 minutes, also divided in two 50 minutes parts with a break, in groups of 40 students where problems and activities proposed after the LECTURES are solved and discussed. This session is focused in helping students to:

  - Understand the statements of the problems.
  - Identify the physical phenomenon involved in the statements and the physical laws describing them.
  - Develop strategies to solve the problems.
  - Learn to make a precise use of mathematics.
  - Analyze critically the results obtained.

- LABORATORY: Four 100 minutes sessions dedicated to perform and analyze experiments about the physical phenomena studied during the LECTURES and the RECITATIONS. The goal of these sessions is to help students learn to:

  - Operate scientific instruments precisely and carefully.
  - Acquire scientific experimental data.
  - Manage and analyze scientific data.
  - Discuss critically experimental results.
  - Report the main results of the experiments.

Additionally, every week there will be one hour tutoring session available to students in the subject

webpage.

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.
- Laboratory reports quality.
- The laboratory experiments and the report's assessment will be done in groups of two students.

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

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

3) End-of-term exam (60% of final mark).

The end of term exam will contain:

- Problems 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 to:

- Attend and deliver the report of the four laboratory sessions,
- Obtain a grade equal or greater than 3 points 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