Physics II

Academic Year: (2019 / 2020) **Review date: 06-05-2020**

Department assigned to the subject: Physics Department
Coordinating teacher: MUÑOZ SANTIUSTE, JUAN ENRIQUE
Type: Basic Core ECTS Credits : 6.0
Year : 1 Semester : 2
Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

First semester Algebra and Calculus courses and knowledge on single particle dynamics.

OBJECTIVES

By the successful completion of this subject, students will be able to have:
1.A knowledge and understanding of the physical principles of electricity and magnetism (RA1.1). To evaluate this RA, partial evaluation tests are carried out throughout the course and a global final exam.
2. The ability to apply their knowledge and understanding to identify, formulate and solve problems of electricity and magnetism using established methods (RA2.1). To evaluate this RA, evaluation tests are performed with specific exercises.
3. The ability to design and carry out experiments on electricity and magnetism, to interpret the data obtained and draw conclusions from them (RA4.2). To evaluate this RA, students perform specific laboratory practices following the guidelines provided, collect data from the experiments and analyze to reach conclusions about the application of physical laws.
4. Skills to work with experimental equipement for data collection in electricity and magnetism practices (RA4.3). To evaluate this RA, students perform the assembly of the laboratory practices by connecting the necessary equipment as specified in the guides provided. experimental equipement for data collection in electricity and magnetism practices (RA4.3). To evaluate this RA, students perform the assembly of the laboratory practices by connecting the necessary equipment as specified in the guides provided.
5. The ability to select and use appropriate tools and methods to solve problems of electricity and magnetism (RA5.1). To evaluate this RA, specific evaluation exercises are carried out.
6. The ability to combine theory and practice to solve problems of electricity and magnetism (RA5.2). To evaluate this RA, exercises, laboratory practices and evaluation tests are carried out throughout the course, as well as a global final exam.

DESCRIPTION OF CONTENTS: PROGRAMME

1 - Coulomb's Law
  1.1 Electromagnetic Interaction.
  1.2 Electric Charge. Charge is quantized. Charge is conserved. The Coulomb's Law
  1.3 The electrical field E, definition and graphical representation: Electric Field lines.
  1.4 The superposition principle. The Electric field due to a system of point charges.
  1.5 Charge density. The Electric field due to a continuous charge distribution.

2 - Gauss's Law
  2.1 The electric Flux
  2.2 Gaussian surfaces, Gauss's Law for Electricity
  2.3 Application of the Gauss's Law for the calculation of electric fields.
  2.4 Charge distributions of sufficient symmetry.

3 - Electric Potential
  3.1 Line integral of E. Electrostatic potential energy.
  3.2 Electric Potential (Voltage), definition and graphical representation: Equipotential Surfaces

3.3 Energy of a point charge arrangement.
3.4 Electrical dipole moment. An electric dipole in a E field.

4 - Electric field in materials: Conductors
4.1 Conductors and Insulators
4.2 Conductors in Electrostatic Equilibrium
4.3 Distribution of the load in conductors in equilibrium.
4.4 Faraday cages, Shielding.

5 - Electric field in materials: Dielectrics.
5.1 Capacity and capacitors. Association of Capacitors
5.2 Charging a Capacitor. Energy Stored on a Capacitor
5.3 Dielectrics. Dielectric Susceptibility and Permittivity
5.4 Polarization P and electric displacement D vectors. Generalization of Gauss's law
5.5 Energy density related to electric field. The energy in problems with dielectrics.

6 - Electric Current
6.1 The electric Current: Intensity and Density of current
6.2 Ohm's law, conductivity and resistance
6.3 Power dissipated in a conductor. Joule's Law
6.4 Electromotive force (EMF)

7 - The Magnetic Field. Magnetic forces
7.1 The magnetic field B. Gauss's law for magnetism.
7.2 The Lorentz force. The motion of electrically charged particles in a Magnetic Field
7.3 Force on a current-carrying conductor in an external Magnetic field.
7.4 Magnetic dipole moment. Effects of field B on a magnetic dipole.

8 - Magnetic field sources
8.1 The magnetic fields produced by currents. The Biot-Savart Law
8.2 Ampère circuitla Law. The calculation of magnetic field of some current-carrying systems
8.3 Magnetism in matter, Magnetization currents, vector magnetization M and vector H.
8.4 Generalization of Ampere's Law
8.5 Magnetic Materials. Introduction to Ferromagnetism

9 - Electromagnetic Induction. Maxwell's Equations
9.1 The Faraday's Law.
9.2 Motional Electromotive force (EMF)
9.3 EMF induced by temporal variation of a magnetic field.
9.4 Some practical applications. Generators, Motors, Eddy Currents.
9.4 Autoinductance and Mutual Inductance. Inductors.
9.5 Energy stored in an inductor. Energy density related to magnetic field
9.6 The Maxwell displacement current. The Ampère-Maxwell's Law
9.7 The Maxwell equations in integral form
9.8 Study of the R + C + L circuits
9.9 Maxwell Equations. Electromagnetic waves

LEARNING ACTIVITIES AND METHODOLOGY

Lectures, where the theoretical concepts are explained

The lecturer 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 student can read about these topics

Recitations (~ 40 students divide in 2-3 people groups) to solve problems.

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 sub-

problems).
- To be careful in the use of mathematics
- To analyze 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 (~ 24 students divide in 2 people groups)

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?

ASSESSMENT SYSTEM

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

Despite the final mark is obtained with the percentages indicated bellow, attendance to the laboratory sessions is COMPULSORY to pass the course. Additionally, it is OBLIGATORY to obtain at least a score of 3 out of 10 in the final exam to pass the course.

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.

Recitation groups (25% of final mark). Evaluation based on:

- Attendance.
- Short test exams.
- Delivery and quality of 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
Consists in:
- Problem solving covering the topics of the program

and perhaps
- Short theoretical questions

BASIC BIBLIOGRAPHY

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

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

ADDITIONAL BIBLIOGRAPHY

- Alan Giambattista, Betty MacCarthy Richardson and Robert C. Richardson College Physics, Fourth Edition, McGraw Hill, 2010

- J.R. Reitz, F.J. Milford y R.W. Christy Foundations of Electromagnetic Theory, Ed. Addison Wesley; ISBN-10: 0321581741; ISBN-13, 2008

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