Physics II

Academic Year: (2024 / 2025) **Review date: 16-04-2024**

Department assigned to the subject: Physics Department

Coordinating teacher: MONGE ALCAZAR, MIGUEL ANGEL

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)

- Linear Algebra
- Calculus I
- Physics I

OBJECTIVES

Upon successful completion of this subject, students will be able to:
1. Have knowledge and understanding of the physical principles of electricity and magnetism.
2. Have the ability to apply their knowledge and understanding to identify, formulate and solve problems of electricity and magnetism using established methods.
3. To have the ability to design and carry out experiments on electricity and magnetism, to interpret the data obtained and draw conclusions from them.
4. Have skills in handling laboratory equipment for data collection in electricity and magnetism practices.
5. Have the ability to select and use appropriate tools and methods to solve problems of electricity and magnetism.
6. Have the ability to combine theory and practice to solve problems of electricity and magnetism.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Coulomb's Law. The Electric Field
1.1 Electric charge.
1.2 Coulomb's Law. Dimensions and Units. The Superposition Principle.
1.3 Definition of the Electric Field.
1.4 Electric Field of Point Charges.
1.5 Superposition Principle. Electric Field Lines.

2. Gauss's Law
2.1 Charge Densities. Electric Field due to different Charge Distributions.
2.2 Electric Flux. Relationship between field flux and electromagnetic fields.
2.3 Gauss's Law.
2.4 Application of Gauss's Law to Calculate Electric Fields in systems with certain symmetry.

3. Electric Potential
3.1 The work done by an electric field on a moving point charge.
3.2 Electric Potential Difference and Electric Potential.
3.3 Electric Potential due to different Charge Distributions.
3.4 Relationship between Electric Field and Electric Potential. Equipotential curves and surfaces.
3.5 Electrostatic Energy of Point Charges.

4. Conductors
4.1 Conductor and Insulator materials; microscopic interpretation.
4.2 Properties of conductors in Electrostatic Equilibrium. Charge Distribution in Conductors.
4.3 Electric Field and Electric Potential in a conductor.

4.4 Electric Fields inside charged conductors. Conductors with charge inside a cavity. The Faraday-s Cage. Corona Discharge.

5. Dielectrics: Capacitance and Energy Storage in electric Fields.
5.1 Microscopic point of view of dielectrics: induced dipoles.
5.2 Dielectric constant and electric susceptibility. Polarization. Electric displacement.
5.3 Definition of Capacitance: Calculation of capacitance.
5.4 Capacitors with Dielectrics.
5.5 Combination of Capacitors. Series and parallel connections.
5.6 Storing energy in a Capacitor. Energy density of the electric Field.

6. Electric Current
6.1 Electric Current: Intensity and Current Density.
6.2 Ohm's Law. Electric Resistance. Conductivity and resistivity of materials.
6.3 Joule-s Law. Power Dissipated in an Electric Conductor.
6.4 Electromotive Force (emf). Combination of resistance. Series and parallel connections.
6.4 RC circuits. Charging and discharging a capacitor.

7. Magnetic Forces and Magnetic Fields
7.1 Introduction. Definition of a Magnetic Field. Lorentz-s Force.
7.2 Charged Particle Movement in a uniform Magnetic Field. Applications: Velocity selector, Mass Spectrometer.
7.3 Magnetic Force on a dipole and on a Current-Carrying conductor wire.
7.4 Torque on a dipole and Current Loop in a constant magnetic field, Permanent Magnets. Magnetic Moment.

8. Sources of Magnetic Field and Magnetic Materials.
8.1 Sources of the Magnetic Field: Current elements. Biot-Savart Law.
8.2 Forces Between Two Current-Carrying parallel wires.
8.3 Magnetic Flux. Ampère-s Law. Application of Ampère-s Law to Calculate Magnetic Fields.
8.4 Magnetic Materials. Microscopic point of view of Magnetism. Magnetization: Magnetic Dipoles. Paramagnetism, Diamagnetism and Ferromagnetism. Magnetic Susceptibility and Permeability.

9. Faraday's Law of Induction
9.1 Faraday's Law of Induction. Lenz-s Law. Applications.
9.2 Motional Electromotive Force.
9.3 Examples of Electromagnetic Induction.
9.4 Mutual Induction and Self-Induction. Energy Stored in a Solenoid.
9.5 Energy Stored in a Magnetic Field.

10. Oscillations. Maxwell's Equations: Electromagnetic Waves
10.1 Introduction to the oscillatory movement. Mathematical description of the oscillatory systems.
10.2 Simple AC circuits: resistive, inductive and capacitive load. The LCR series circuits. Impedance. Resonance.
10.3 Introduction to travelling Waves and Standing Waves: Mathematical Description. Mechanical waves, Sound and Electromagnetic Waves. One-dimensional wave Equation.
10.4 Displacement Current: Gauss´s Law for Magnetism: Maxwell's Equations. Plane Electromagnetic Waves. Energy Flux Density of an Electromagnetic Wave.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures, where the theoretical concepts are explained and personal work of the student. They are aimed at the acquisition of theoretical knowledge.

- The teaching format will be:

1) Master classes (aggregated groups) on-line. Through Video-Conference preferably using BlackBoard Collaborate or Google Meet.
2) Small groups: Face-to-face.

- Practical laboratory sessions of mandatory attendance; practical sessions for small groups, with active and direct interaction between the students and the professor; individual tutor supported sessions and students personal work. They are aimed at the acquisition of practical skill related to the syllabus of the subject .

1) Master classes (aggregated groups) on-line. Through Video-Conference preferably using BlackBoard Collaborate or Google Meet.
2) Small groups: Face-to-face.

ASSESSMENT SYSTEM

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

Assessment system:

1- Laboratory sessions (15% of final mark)
Attendance to the laboratory sessions is compulsory.
Evaluation of the reports. The mark is shared by the members of the group.

2- Activities in groups (25% of final mark)
Attendance.
Short test exams.
Delivery and evaluation of the proposed activities

3- 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
Contents:
Problems to be solved covering the topics of the program and perhaps
Short theoretical questions

4- Mandantory evaluation criteria:
- Attendance and participation in all laboratory sension is mandatory.
- Students must get a minimun grade of 3 pts, of a maximun of 10 pts, in the end of term examination.

Failure to meet this two criteria will result in a failing grade (F: Suspenso) for the course.

BASIC BIBLIOGRAPHY

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

- Raymond A. Serway, John W. Jewett Physics for Scientists and Engineers, 6th Edition Ed. Brooks Cole, ISBN: 0534408427, ISBN-13: 9780534408428, 2003

ADDITIONAL BIBLIOGRAPHY

- HEWITT PG. Conceptual Physics, PEARSON..

- Hewwitt PG Conceptual Physics, 12th Edition, PERSON, ISBN: 9780321909107

BASIC ELECTRONIC RESOURCES

- MIT . Electromagnetism: https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/