# Electromagnetism and Optics

**Academic Year: ( 2022 / 2023 )** **Review date: 20-06-2022**

**Department assigned to the subject: Department of Physics**

**Coordinating teacher: LEGUEY GALAN, TERESA**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 2 Semester : 2**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I, Physics II, Differential Equations

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Electrostatics in vacuum. Coulomb¿s law. Electric field. Differential and integral formulations of the equations of electrostatics. Electric dipole. Multipolar formalism.
2. Electrostatics in material media. Polarization vector. Polarization charge densities. Electric displacement vector D. Electric susceptibility and permitivity. Boundary conditions for D and E. Electric forces and electric energy.
3. Magnetostatics in vacuum. Electric current and current density. Magnetic induction vector B. Biot-Savart Law. Ampere¿s law. Differential and integral formulation of magnetostatics. Magnetic vector potential. Magnetic dipole. Magnetic scalar potential.
4. Magnetostatics in material media. Magnetization vector. Magnetization currents and magnetic poles. Magnetic intensity vector H. Magnetic susceptibility and permittivity. Boundary conditions for B and H. Magnetic forces and magnetic energy.
5. Electromagnetic fields. Faraday¿s law. Self- and mutual inductance. Displacement current. Maxwell equations. Poynting vector and Poynting¿s theorem. Electromagnetic moment and energy.
6. Electromagnetic waves. Plane waves. Paraxial aproximation and Geometrical Optics Reflection and refraction laws. Polarization of light. Fresnel coefficients. Propagation of waves in dielectric and conducting media.
7. Electromagnetism and the theory of special relativity. The electromagnetic tensor.

## LEARNING ACTIVITIES AND METHODOLOGY

1) LECTURES: where the theoretical concepts are explained
The lecturer will provide with the following information (1 week in advance)
- Main topics to be discussed during the session (short description)
- Chapters/sections in each of the text books provided in the bibliography where the student can read about these topics.

2) RECITATIONS: Discussion sessions and activities in small groups to solve problems:
The lecturer will provide a file with problems (few days in advance)
The main skills to be acquired in these activities are:
- To understand the statement of a problem
- To identify the physical laws involved.
- To develop a solving strategy to reach the objective (by simplification, studying similar problems already solved¿
- Training in mathematical skills
- To analyze the reasonability of the result (order of magnitude, dimensional analysis¿)

3) LABORATORY: sessions dedicated to perform and analyze experiments
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 apply Experimental measurement and data analysis techniques.
- 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.

## ASSESSMENT SYSTEM

1) Laboratory sessions (20% 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) Assessment during the course (20% of final mark)
- Midterm exams
- 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
- Short theoretical questions.

The minimum required grade in each one of the sections of the final exam is 3/10.

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

## BASIC BIBLIOGRAPHY


- David J. Griffiths Introduction to Electrodynamics, Pearson.
- Roald K. Wangsness Electromagnetic Fields, John Wiley & Sons.


## ADDITIONAL BIBLIOGRAPHY


- Andrew Zangwill Modern Electrodynamics, Cambridge University Press.
- F. Salazar at al. Solved problems in electromagnetics, Springer, 2017
- John D. Jackson Classical Electrodynamics, John Wiley & Sons.


## BASIC ELECTRONIC RESOURCES


- A. J. de Castro, J.R. Martín Solís . Problemas de Electromagnetismo: http://hdl.handle.net/10016/32231