Syllabus
2021 - 2022

# TECHNICAL SHEET OF THE SUBJECT

| Data of the subject | |
|---|---|
| Subject name | Electricity and Magnetism |
| Subject code | DIE-SAP-212 |
| Level | Intercambio |
| Quarter | Semestral |
| Credits | 6,0 ECTS |
| Type | Optativa |
| Department | Department of Electrical Engineering |
| Coordinator | Danilo Magistrali |

| Teacher Information | |
|---|---|
| **Teacher** | |
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# SPECIFIC DATA OF THE SUBJECT

## Contextualization of the subject

### Contribution to the professional profile of the degree

Conceptual-based introduction to classical electricity and magnetism, including such topics as, electric charge and electric fields, Gauss's law, electric potential, capacitance, current, resistance, and circuits, magnetic fields, and fields due to currents, induction and inductance, magnetism of matter, Maxwell's equations, and electromagnetic oscillations. These topics are important, not only because they are extremely interesting in their own right, but also because they underlie almost all of modern technology, from computers to telecommunications, all of chemistry, and all of biology as well.

### Prerequisites

Vector Calculus

## Competencies - Objectives

### Competences

1. To analyze physical situations involving static electric charge.

2. To analyze direct current circuits.

3. To analyze physical situations involving magnetic fields and magnetic induction.

4. To analyze alternating current circuits.

5. To verify experimentally some of the laws of electricity and magnetism.

## Learning outcomes

1. Students will be able to conduct qualitative analysis of electromagnetism problems which demonstrates conceptual understanding as measured by performance in visualizing problems through diagrams, estimating answers, assessing and justifying answers, analyzing graphs and clear, written explanations.

2. Students will be able to perform quantitative calculations in situations involving electric and magnetic fields, and demonstrate knowledge of the relevant basic units, vector addition, and application of basic calculus. Students will be able to assess answers to questions for plausibility.

3. Students will be able to use simple laboratory demonstrations and computer simulations to explain the basic properties of electric and magnetic fields, and electrical circuits.

# THEMATIC BLOCKS AND CONTENTS

## Contents - Thematic Blocks

**1. The Electric Field**
1.1 Charge and Coulomb's law
1.2 The electric field
1.3 Point-charge distributions
1.4 Continuous charge distributions
1.5 Motion of charged particles in an electric field

**2. Gauss's Law**
2.1 Electric flux
2.2 Gauss's law
2.3 Gauss's law and various continuous charge distributions

**3. Electric Potential**
3.1 Electric potential and potential difference
3.2 Potential differences in uniform electric fields
3.3 Potential and point charges
3.4 Potential and continuous charge distributions

**4. Circuits**
4.1 Ohm's law
4.2 Electromotive force and internal resistance
4.3 Equivalent resistance
4.4 Kirchhoff's rules

**5. Magnetostatics**
5.1 Magnetic force on moving charges and currents
5.2 Biot-Savart law
5.3 Ampere's law

**6. Magnetic Induction**
6.1 Gauss's law of magnetism

6.2 Faraday's law of induction

6.3 Lenz's law

6.4 Induced emf and electric fields

6.5 Maxwell's equations

**7. Electromagnetic Waves**

7.1 Polarization

7.2 Reflection and Refraction

7.3 Lenses and mirrors.

7.4 Optical Instruments

## TEACHING METHODOLOGY

### General methodological aspects of the subject

#### In-class Methodology: Activities

**Magistral class**: The teacher will explain the subject's basic concepts as well as the relations between them. The material explained in each class will be based on the material taught in the previous ones; for this reason, to obtain the best results it is key to deeply assimilate previously learnt concepts. In addition, the student is recommended to bring to each class the material that corresponds to it.

**Practical class:** In each session we will discuss the exercises that the student worked out at home and we wil present new probems to be solved in class. Quizzes will be administered as independent activities. The work may be submitted upon teacher's request at the end of a class.

**Midterm exams**: depending of the topic, midterm exams they will have different formats and be more or less comprehensive; they will be designed to assess the student's understanding of the subject

#### Non-Presential Methodology: Activities

**Preparation for the magistral class:** At the end of each class the students are supposed to figure out what they have learned and supplement it with the provided material. The student who does not achieve an optimum performance in the master class will be expected to talk to their teacher in order to identify the sources of their problem.

**Preparation for the practical class**: The student is expected to solve the exercises that the teacher will indicate before each practical class.

**Preparation and analisis of midterm exams**: At the end of each topic, the student is expected to review all the concepts that they have have learned and understand the relationships that exist between them and with the concepts learned in previous topics. When the student receives a graded test they should critically analyze their mistakes and talk to the professor in case the score does not correspond with their expectations.

**Assignments**: the students are expected to solve problems and exercices

## EVALUATION AND CRITERIA

The grade will be determined by two midterms (25% each), homework (10%), and a final examination (40%). The exams are all closed notebook, closed textbook and no calculator. The course will not be graded on a curve, i.e., there is no bound on the numbers of A's, B's, C's etc.

Students will have the chance to retake the exam. The resulting grade will be computed as follows: 30% of midterms and 70% of the final exam.

## BIBLIOGRAPHY AND RESOURCES

### Basic Bibliography

Young, Hugh D., and Roger A. Freedman (2012). *University Physics with modern Physics*. 13th edition, San Francisco, CA: Addison-Wesley.