Electricity and Magnetism

Code: 107592
ECTS Credits: 6

2025/2026

Degree	Type	Year
Physics	FB	1

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

To take this course it is recommended that the student has the knowledge of mathematics and physics of the baccalaureate.

Objectives and Contextualisation

In this subject we intend to teach in a qualitative and quantitative way how to reason to understand aspects of the world around us and develop skills in solving problems. These skills will be developed in the framework of electrostatics, magnetostatics, electrical circuits and electromagnetism. We will make special emphasis on explaining the phenomena associated with electrostatics (resting charges) and the magnetostatics (stationary currents). The electromagnetic force, one of the four fundamental forces, has many applications in the world around us, so understanding it is key. We will see the most relevant applications.

Through an inductive process, we will arrive at the four Maxwell equations, which form the basis of the classical theory of electromagnetism, and we will see how electromagnetic waves are a consequence. Electromagnetism has a significant mathematical load. As there is a specific subject of electromagnetism to the second year and the subject is part of a General Physics course, our description will be more qualitative, enhancing the conceptual aspects.

At the end of this course students should be trained to:

Describe the vectorial nature of the electric field and its relationship with the scalar potential.

Understand Gauss's law, its generality and relationship with Coulomb's law and calculate electric fields using both laws.

Describe the vector nature of a static magnetic field and be able to calculate the magnetic field using the law of Biot and Savart and / or the law of Ampere.

Relate electric and magnetic fields in the application domain of Faraday-Lenz law.

Know and understand Maxwell's equations in an integral way.

Understand the operation of devices that make use of electromagnetismfor its operation, especially the different types of circuits in both direct and alternating current.

Learning Outcomes

1. CM01 (Competence) Solve problems in the sciences using the fundamentals of the main areas of physics in a professional context.
2. CM02 (Competence) Evaluate the principal magnitudes involved in a given basic physical system, manipulating them according to fundamental physical laws to draw conclusions about the predictable behaviour of the system under study.
3. KM03 (Knowledge) Identify the fundamentals, methods, and essential laws of electricity and magnetism.
4. KM03 (Knowledge) Identify the fundamentals, methods, and essential laws of electricity and magnetism.
5. KM03 (Knowledge) Identify the fundamentals, methods, and essential laws of electricity and magnetism.
6. SM01 (Skill) Correctly use scientific language, magnitudes and units associated with fundamental physical concepts.
7. SM02 (Skill) Apply the theory, fundamentals and numerical methods of general physics to the resolution of simple problems and the explanation of experimental phenomena.

Content

1.- Electrostatics

1.1 Law of Coulomb. Principle of Superposition

1.2 Electric field and field lines.

1.3 Discrete and continuous distributions of electric charge.

1.4 Law of Gauss

1.5 Electric potential

1.6 Electrostatic energy

1.7 Electric field in conductors

1.8 Capacity and capacitors. Association of capacitors.

2.- Electric current

2.1 Intensity and current density

2.2 Law of Ohm. Electric conductivity.

2.3 Resistance association. Joule effect

2.4 Batteries

2.5 DC circuits. Kirchhoff Rules

2.6 Charging and discharging a capacitor

3.- Magnetostatic

3.1 Magnetic force Lorentz Force

3.2 Moment about current turns. Hall effect.

3.3 Law of Biot-Savart.

3.4 Force between circuits: Ampere law

3.5 Magnetism of matter.

4.- Electromagnetism

4.1 Electromagnetic induction. Law of Faraday-Lenz

4.2 Inductance. Magnetic field energy

4.3 Generalized Ampere Law.

4.4 Eqs. of Maxwell.

4.5 Electromagnetic wave equation.

4.6 Electromagnetism and relativity

5.- Alternating current circuits

5.1 Effective value. fasores

5.2 Circuits without generator (LC, RLC)

5.3 Circuits with generator (RLC)

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem solving	19	0.76	CM01, CM02, CM01
Seminars	8	0.32	CM01, CM02, SM01, SM02, CM01
Theory	26	1.04	CM02, KM03, SM01, CM02
Type: Supervised			
Tutorials	3	0.12	SM02, SM02

Type: Autonomous			
Homework	40	1.6	CM02, SM02, CM02
Study and exam preparation	42	1.68	

This course offers a diversified education, with the different training activities described below. The work hours that are specified for each training activity correspond to an average student. Naturally, not all students need the same time to learn concepts and carry out certain activities, so the distribution of time should be understood as guidance. In this subject, the active student participation is a key tool to enhance learning beyond simple repetition and memorization. We believe it is very important that the student prepares the class before attending, since undoubtedly this active participation will improve your learning. To facilitate this active attitude, at the beginning of the course students are given a table with the calendar of the different sessions, indicating, each day, the type of training activity what will take place and its content. The students will know the first day that, for example, on May 5 they will be explained in a master class the Faraday-Lenz law.

Directed training activities:

Lectures: Classes in which the theory teacher explains the most relevant concepts of each subject. The students will have the transparencies of the master class in pdf format in advance and inside the UAB's virtual campus. In order to make the most of master class sessions, it is very important that the student read before attending each session the material accessible on the network (virtual campus) corresponding to that session, as well as the reference text pages where the concepts of the session are explained. Most lessons will also include conceptual tests.

Learning through conceptual tests (conceptual test learning): These sessions will complement the master classes. They consist in the resolution by students of some tests that are designed in order to better understand the concepts which have been explained in the master class. After thinking individually what is the correct answer, we proceed to a few minutes of discussion among the students and then ask again which option they think is the correct one. The objective of this activity is to help the student to reach the key concepts that have been explained in the master session of the same day, encouraging both the individual reflection and the discussion between peers (peer learning).

Problem solving: Classes in which the problem teacher explains to the students how to solve the type problems of the subject. The teacher will resolve in detail a list of selected problems, and will propose to the students a list of problems that may be delivered optionally.

Group work sessions: In these classes students' active participation will be requested, either by solving problems that the teacher proposes, posing questions, presenting papers, etc.

Supervised training activities: Tutorials: in the hours of attention to the students, the teachers will be available for the consultations of the students who have doubts in any of the subjects of the agenda.

Autonomous training activities: Preparation of master classes: the student must prepare the master classes in advance, consulting both the material available on the virtual campus and the reference bibliography.

Active learning: undesrtanding concepts through specific videos and practicing them in class.

Problem solving and delivery of additional problems: the student must solve the problems of the list given by the teachers and the additional ones that the teacher asks of problems or those that the student wants to do on their own to prepare the subject better.

Study and preparation of exams: Personal work of the student to acquire the theoretical concepts of the subject and the abilities for the resolution of problems.

Preparation and delivery of individual works: eventually, the teacher willask the students to perform small individual works, typically within the sessions of group activities.

Contest: the professors will propose to the students the realization ofan experimental work (construction of a device) related to electromagnetism.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
exam --- 1st	40%	3	0.12	CM01, KM03, SM01, SM02
exam -- 2nd	40%	3	0.12	CM01, CM02, KM03, SM01, SM02
Group activities	20%	3	0.12	CM01, CM02, KM03, SM01, SM02
re-evaluation	80%	3	0.12	CM01, CM02, KM03, SM01, SM02

he final grade is obtained considering the grade of each formative activity according to the weight that has been indicated; that is, using the formula: final grade = evaluation partial content 1 x 0.40 + evaluation partial content 2 x 0.40 + evaluation group activities / seminars x 0.20

To be able to apply this formula, it is necessary that the note (out of 10) of each of the partials is equal to or greater than 4. In the case that in partial 1 or 2 the grade is less than 4, the student must be presented to the repechage either of the whole course, or of the part that has suspended with a grade lower than 4.

If any student, despite having the approved subject, wants to improve the grade, he / she can submit to the repechage to the part he / she wants (partial1, partial2, or the whole course) with the understanding that for the final grade it will be considered the note obtained in the repechage. There is no possibility of improving the grade corresponding to group activities, the problems delivered and the contest.

Important: Due to the new regulations, students must have realized the two partial exams to make the recovery exam.

Single appraisal

The students who have joined the single assessment modality will have to carry out a final test that will consist of a theory exam on which they will answer a series of questions on the subject. Then there will be a test of problems on which you will have to solve a series of exercises similar to those who have worked in the sessions of problems of the subject. When you have finished, you will have problem resolutions that will be similar to those you are a fan of during the seminar sessions. These proofs last until the end of the day, the hour and place that you prove them from the partial second of the continuous evaluation modality.

The qualification of the student will be the weighted half of the three previous activities, on the theory exam it will suppose 40% of the note, the problem exam 40% and the reports with the resolutions of the exercises 20%.

If the final grade does not reach 5, the student will have another opportunity to pass the subject by taking the recovery exam that will be held on the date set by the coordination of the degree. In this test you will be able to recover 80% of the note corresponding to the theory and the problems.

The part of seminaris is not recoverable

Bibliography

Notes at campus virtual

Tipler y Mosca. Física para la ciencia y la tecnología. Volum 2. Editorial Reverté. 6a Edició, 2010.

Young y Freedman. Física Universitaria. Volum 2. Editorial Addison-Wesley. 12a edició, 2009.

Software

Not required.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan/Spanish	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	afternoon
(SEM) Seminars	1	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	2	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	3	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	4	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	1	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	2	Catalan	second semester	morning-mixed