UAB
Universitat Autònoma de Barcelona

General Physics: Electricity and Magnetism

Code: 106798
Credits: 6

2026/2027

Degree programme	Type	Course
Nanoscience and Nanotechnology	FB	1

Contact lecturer

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Teaching staff

Josep Gutiérrez Martínez

Group languages

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

Prerequisites

High school level in physics and mathematics is highly recommended.

Objectives

1. To describe the vectorial nature of the electric field and its relation with the scalar potential.
2. To understand the Gauss law, its generality and its relation with Coulomb's law. Use both to calculate electric fields.
3. To describe the vectorial nature of the static magnetic fields. To be able of calculating the magnetic field using Biot-Savart's law and/or Ampere's law.
4. To relate electric and magnetic fields in the domain of applicability of Faraday's law.
5. To understand the devices that use electromagnetism, especially the different circuit types in both ac and dc current cases.
6. To know the Maxwell Equations and the electromagnetic nature of light.

Learning outcomes

- CM01 (Determine the parameters and magnitudes associated with solving problems in the field of general physics.) Determine the parameters and magnitudes associated with solving problems in the field of general physics.
- CM02 (Work in teams to plan and carry out theoretical and practical case studies in the field of general physics.) Work in teams to plan and carry out theoretical and practical case studies in the field of general physics.
- KM03 (Recognise the fundamental principles and methods of electricity and magnetism.) Recognise the fundamental principles and methods of electricity and magnetism.

- KM04 (Recognise the electromagnetic nature of light and its relation to Maxwell's laws.) Recognise the electromagnetic nature of light and its relation to Maxwell's laws.
- SM01 (Express oneself correctly using scientific language, magnitudes and units associated with fundamental physical concepts.) Express oneself correctly using scientific language, magnitudes and units associated with fundamental physical concepts.
- SM02 (Use the theory, principles and methods of general physics to solve simple problems and explain experimental phenomena.) Use the theory, principles and methods of general physics to solve simple problems and explain experimental phenomena.
- SM03 (Analyse and adequately represent data and observations in the field of physics.) Analyse and adequately represent data and observations in the field of physics.
- SM04 (Understand how to implement basic techniques, materials and instruments in a general physics laboratory safely.) Understand how to implement basic techniques, materials and instruments in a general physics laboratory safely.

Contents

THEORETICAL CONTENTS:

- Electrostatics: Electric charge and Coulomb's law. Electric field. Discrete and continuous charge distributions. Electric potential. The energy of a charge distribution. Conductors.

- Magnetostatics: Electric current. Ohm's law. Magnetic induction field: Biot-Savart's law. Lorentz force. Ampere's law. Displacement current.

- Materials: Electric dipole and magnetic dipole. Dielectrics. Polarization. Dielectric constant. Magnetic materials. Magnetization. Types of magnetic materials.

- Slowly varying fields: Electromotive force. Electromagnetic induction: Faraday's law. Mutual and self-inductance. Transformers. The magnetic energy of coupled circuits.

- Electric circuits: RC, RL and RLC circuits.

- Electromagnetic waves: Maxwell equations. Electromagnetic waves. Electromagnetic spectra.

PRACTICUM:

- Introduction.

- Coulomb's force.

- AC/DC circuits. Multimeter and oscilloscope.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Laboratory report's preparation	9	0.36	CM01, CM02, KM03, SM01, SM02, SM03
Laboratory guide's reading	3	0.12	CM01, CM02, KM03, SM02
Practice work	8	0.32	CM01, CM02, KM03, SM01, SM02, SM03, SM04
Study and preparation of exams	27	1.08	CM01, CM02, KM03, KM04, SM01, SM02, SM03
Personal (small group) work	10	0.4	CM01, CM02, KM03, KM04, SM01, SM02, SM03
Preparation of lectures	16	0.64	CM01, CM02, KM03, KM04, SM01, SM02, SM03
Theoretical lectures	32	1.28	CM01, KM03, KM04, SM01, SM02, SM03
Solving problems	24	0.96	CM01, CM02, KM03, KM04, SM01, SM02, SM03
Problems lectures	12	0.48	CM01, KM03, KM04, SM01, SM02, SM03

Guided Learning Activities

- Development of the core theoretical content: Lectures in which the theory instructor presents the most relevant concepts of each topic in a structured manner, providing the necessary written materials as well as guidance on how to complement learning through the recommended bibliography and other resources (preferably online). Face-to-face sessions will be primarily devoted to answering questions and providing guidance on the most important aspects of the course.
- Problem-solving sessions: The problem-solving instructor will explain and provide the necessary materials to solve representative course problems, as well as guidance on how to complement learning through the recommended bibliography and other resources (preferably online). Face-to-face sessions will be mainly devoted to answering questions and emphasizing the key aspects involved in solving the problems.
- Laboratory work: Throughout the course, students will complete a series of laboratory practical sessions in the faculty laboratories.

Supervised Learning Activities

- Tutorials: The teaching staff will be available to answer students' questions about any course topic during scheduled office hours or by prior appointment.

Independent Learning Activities

- Preparation for lectures: Students are expected to prepare for theory classes in advance by reviewing the materials available on the virtual campus, consulting the recommended bibliography, and using the online reference resources that will be indicated throughout the course.
- Preparation for laboratory sessions: Students are expected to prepare for practical sessions in advance

by carefully reading the instructions and completing the required tasks for each stage of the course, which will be made available through the virtual campus.
- Problem solving: Students are expected to solve the problems included in the problem sets provided by the teaching staff. The problem-solving sessions will primarily focus on addressing students' questions and highlighting the key steps and concepts involved in the solutions.
- Study and examination preparation: Independent work by students to acquire the theoretical knowledge of the course and develop the skills required for solving problems.
- Preparation of laboratory reports: Students, working in groups, are required to prepare and submit reports for the different laboratory sessions.

AI Use (Restricted)

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as preparing course materials in advance, gaining a deeper understanding of concepts covered in class (although the use of the recommended bibliography is encouraged), resolving both theoretical and practical questions, including problems and practical assignments (although students are strongly encouraged to attend tutorials with the course teaching staff for these tasks in particular), translating texts, or any other support-related activity. However, the use of AI is not permitted in assessment activities. Any work submitted for assessment that contains AI-generated content will be considered a breach of academic integrity and may result in a partial or total penalty in the activity's grade, or more severe disciplinary sanctions in serious cases.

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.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Delivered activities	0%	0	0	CM01, CM02, KM03, SM01, SM02, SM03
Retake Exam	Up to 80%	3	0.12	CM01, KM03, KM04, SM01, SM02, SM03, SM04
2nd Partial Exam	40%	3	0.12	CM01, KM03, KM04, SM01, SM02, SM03
Laboratory report evaluation	20%	0	0	CM01, CM02, KM03, SM01, SM02, SM03, SM04
1st Partial Exam	40%	3	0.12	CM01, KM03, SM01, SM02, SM03

Continuous Assessment:

The final mark of the course will be obtained using the following proportions:

- 1st Partial Exam --> 40%

- 2nd Partial Exam --> 40%

- Laboratory reports --> 20%

- Delivered activities --> These can help to increase the mark of the partial exams but only in those cases in which the mark of the parcial exams is equal to or higher than the minimum mark. In no case will the improvement of the mark be applied to those partial exams whose mark is lower than the minimum mark (see details below).

Single Assessment

Students who opt for the single assessment will have to take two exams corresponding to the partial exams (each one will have a weight of 40%) on the day on which the continuous assessment students take the Partial 2 exam. On the same day, at the end of these exams, they will have to hand in the reports of the practicals carried out (with a weight of 20%) and the resolution of the problems of the deliveries (these are voluntary and will allow the improvement of the mark of the mid-term exams). In the case of single assessment students, both the practical reports and the deliveries must be done individually.

Both single and continuous assessment students will pass the course if the mark obtained by applying the different percentages is equal to or higher than 5.0 (out of 10). However, in order to be able to apply these percentages it is necessary that the mark (out of 10) of each of the partial exams is equal to or higher than 3.5 and that all the laboratory practicals, which are compulsory for all students, have been completed. In the case that in one or both of the two partial exams the mark is lower than 3.5, the student will have to take the retaking exam of the failed part with a mark lower than 3.5. Both in the single assessment and in the continuous assessment the recovery process will be the same, but in each case, the specific date will be the one foreseen by the coordinationof the degree. The retaking exam will consist of a retaking exam for Partial 1 and another for Partial 2. The mark of the retake exam will replace the mark of the corresponding partial exam.

The laboratory reports and the problems of the deliveries cannot be retaken.

UAB Regulations: To be able to retake partial exams, the student must have previously been evaluated in a set of activities the weight of which is equivalent to a minimum of two-third parts of the total qualification of the subject. Students who have been evaluated only 1/3 or less of the total subject will be considered \"Not Evaluable\".

UAB Regulations: In the event that the student realizes any irregularity that might lead to a significant variation in the qualification of some evaluation activity, he or she will qualify with 0 for this evaluation activity, irrespective of the disciplinary process that could be started. If there are several irregularities in the evaluation of the same subject, the final qualification of this subject will be 0. Any plagiarism (total or partial), copying or attempted copying, letting oneself be copied, etc., in any of the evaluable activities will be considered \"irregularities leading to a significant variation in the qualification\".

Bibliography

*Theoretical lecture notes (available on the Campus Virtual).

*Tipler, Paul Allen & Mosca, Gene. (2008). Physics for scientists and engineers with modern physics. (6th ed.) W H Freeman and Company

*Tipler, Paul Allen & Mosca, Gene. (2010). Física per a la ciència i la tecnologia. (Traducció de la 6a ed. nord-americana) Reverté

*Tipler, Paul Allen & Mosca, Gene. (2010). Física per a la ciència i la tecnologia vol. 2 : Electricitat i magnetisme. (2nd ed.) Editorial Reverté

*Alonso, Marcelo & Finn, Edward J. (1995). Física. Addison-Wesley Iberoamericana

*Feynman, Richard P. & Sands, Matthew L. & Leighton, Robert B. (2013). The Feynman lectures on physics. California Institute of Technology

*Serway, Raymond A. & Jewett, John W. (2008). Física : para ciencias e ingeniería. (7ª ed.) Cengage Learning

*Serway, Raymond A. (2019). Physics for scientists and engineers with modern physics.(10th ed.) Cengage Learning

*Wangsness, Roald K. (1986). Electromagnetic fields. (2nd ed.) Wiley

*Wangsness, Roald K. (1983). Campos electromagnéticos. Limusa

Software

No specific software is needed.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	second semester	afternoon
(PAUL) Classroom practices	1	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	4	Catalan	second semester	morning-mixed