Universitat Autònoma de Barcelona

2023/2024

General Physics: Electricity and Magnetism

Code: 106798
ECTS Credits: 6

Degree	Type	Year	Semester
2504602 Nanoscience and Nanotechnology	FB	1	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

External teachers

Enric Menéndez Dalmau

Prerequisites

High school level in physics and mathematics is highly recommended.

Objectives and Contextualisation

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 (Competence) Determine the parameters and magnitudes associated with solving problems in the field of general physics.
- CM02 (Competence) Work in teams to plan and carry out theoretical and practical case studies in the field of general physics.

- KM03 (Knowledge) Recognise the fundamental principles and methods of electricity and magnetism.
- KM04 (Knowledge) Recognise the electromagnetic nature of light and its relation to Maxwell's laws.
- SM01 (Skill) Express oneself correctly using scientific language, magnitudes and units associated with fundamental physical concepts.
- SM01 (Skill) Express oneself correctly using scientific language, magnitudes and units associated with fundamental physical concepts.
- SM02 (Skill) Use the theory, principles and methods of general physics to solve simple problems and explain experimental phenomena.
- SM03 (Skill) Analyse and adequately represent data and observations in the field of physics.
- SM03 (Skill) Analyse and adequately represent data and observations in the field of physics.
- SM04 (Skill) Understand how to implement basic techniques, materials and instruments in a general physics laboratory safely.

Content

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.

Methodology

Guided activities:

- Basis Theory: The lecturer will give the basic concepts in each chapter, in an ordered way, providing the needed written material and the indications for complementing the study with the bibliography and other resources (preferably virtual). The classroom classes will be devoted mainly to solving the doubts and to the orientation in the study of the most relevant aspects of the subject.

- Problem lectures: The problems lecturers will explain, and provide the needed material, on how to solve the typical problems of each part. Also, they will provide the necessary material and/or indications for completing the study with the bibliography and extra resources (preferably virtual). The classroom classes will be devoted mainly to solving doubts and emphasizing the key points in the problem-solving process.

- Laboratory work: Several practices will be done during the course. They could be made at the faculty labs.

Supervised activities:

- Personal (small group) work: During the students' attention time, the lecturers will be available to solve individual questions.

Autonomous activities:

- Preparation of lectures: Students have to prepare the lectures, by checking the virtual campus for the provided
material.

- Preparation of practice work: Students have to prepare the practice work, follow the indications, and do the tasks that will be given on the virtual campus.

- Solving problems: Students have to solve the problems of the list given by the lecturers, independently of the problem classes done. The classroom classes will be used basically for solving the doubts that could have emerged and to indicate the key points in the resolution.

- Study and preparation of exams: Personal work of the student to acquire the theoretical concepts as well as the ability to solve problems.

-Preparation of the lab reports: By groups, the students will have to draw up the reports of the different practicals.

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.

Activities

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

Study and preparation of exams	27	1.08	CM01, CM02, KM03, KM04, SM01, SM02, SM03, CM01

Assessment

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 grade of the partial exams.

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 coordination of 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".

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st Partial Exam	40%	3	0.12	CM01, KM03, KM04, SM01, SM02
2nd Partial Exam	40%	3	0.12	CM01, KM03, KM04, SM01, SM02

Delivered activities	0%	0	0	CM01, CM02, KM03, KM04, SM01, SM02
Laboratory report evaluation	20%	0	0	CM01, CM02, KM03, KM04, SM01, SM02, SM03, SM04
Retake Exam	Up to 80%	3	0.12	CM01, KM03, KM04, SM01, SM02

Bibliography

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

*P. A. Tipler, G. Mosca, Physics: for scientists and engineers. W. H. Freeman Company. 6a edició (2008).

*M. Alonso, E.J. Finn. Física. Addison-Wesley Iberoamericana. (1995)

*F. W. Sears, M. W. Zemansky, H. D. Young, R. A. Freedman. Física Universitaria. Addison-Wesley. 12a edició (2009).

*R. P. Feynman, R. B. Leighton, M. Sands, The Feynman lectures on physics. Addison-Wesley. 6à impressió (1977).

*R. A. Serway, Física para ciencias e ingenierías. International Thompson. 6a edició (2005).

*R. K. Wangsness, Campos electromagnéticos. Ed. Limusa (1983).

Software

No specific software is needed.