UAB
Universitat Autònoma de Barcelona

Foundations of Physics

Code: 102707
ECTS Credits: 9

2024/2025

Degree	Type	Year
2500895 Electronic Engineering for Telecommunication	FB	1
2500898 Telecommunication Systems Engineering	FB	1

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Teachers

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Teaching groups languages

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

Prerequisites

It is highly recommended that the student:

1. Know the basic operations with vectors: addition, subtraction, scalar product and vector product.
2. Be able to make derivatives of functions of one variable.
3. Know how to integrate functions of one variable with the help of an integrals table.
4. Have notions of integrals of line, surface and volume, and partial derivatives.

Objectives and Contextualisation

A basic knowledge of the electromagnetic field. From electrostatics and magnetostatics (in vacuum and in materials) to Maxwell's equations, going through electromagnetic induction.

Several solutions of Maxwell's equations are given, including electromagnetic waves.

Brief introduction to wave movement, mechanics and thermodynamics

Competences

Electronic Engineering for Telecommunication

- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.

Telecommunication Systems Engineering

- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.

Learning Outcomes

1. Apply the basic concepts on the general laws of mechanics, thermodynamics, and electromagnetic fields and waves to resolve engineering problems.
2. Define the basic concepts on the general laws of mechanics, thermodynamics, and electromagnetic fields and waves.
3. Develop independent learning strategies.
4. Develop scientific thinking.
5. Develop the capacity for analysis and synthesis.
6. Manage available time and resources.
7. Manage available time and resources. Work in an organised manner.
8. Prevent and solve problems.
9. Work autonomously.

Content

1. Vector analysis
Vector Algebra.- Gradient.- Divergence.- Divergence theorem.- Rotational.- Stokes' theorem.- Helmholtz's theorem.- Other coordinate systems.

2. Electrostatics
Electric charge and Coulomb's law.- Electric field.- Electric field equations.- Electric potential.- Poisson's and Laplace's equations.- Conductors.- Energy of a charge distribution.

3. Magnetostatics
Electric current and Ohm's law.- Continuity equation.- Magnetic induction: Biot and Savart law.- Force between circuits.- Lorentz force.- Rotational of B: Ampère's theorem.- Divergence of B.- Potential vector.

4. Dielectric media
Multipolar development.- Electrical dipole and magnetic dipole.- Field created by a dielectric.- Vector Displacement D.- Dielectric constant.- Field created by a magnetic material.- Magnetic intensity H.- Types of magnetic materials.

5. Slowly variable fields

Electromotive force.- Law of Faraday.- Applications.- Differential expression.- Mutual inductance and selfinductance.- Transformer.- Magnetic energy of several circuits.- Energy in function of the field.

6. Electromagnetic fields
Displacement current.- Maxwell equations.- Boundary conditions.- Scalar and potential vector.- Poynting's theorem.- Electromagnetic radiation.

7. Waves
Properties of waves.- Wave equation.- Superposition of waves.- Electromagnetic waves in a dielectric.- Electromagnetic waves in a conductor.- Guided waves.- Electromagnetic spectrum.

8. Fundamentals of Mechanics and Thermodynamics
Newton's Laws.- Kinetic and potential energy.- Rotation of a rigid body.- Harmonic oscillator.- Temperature and heat.- Heat transfer.-Thermal properties of matter.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes	45	1.8	1, 2, 4, 5
Problem sessions	30	1.2	1, 5, 7, 8, 9
Type: Supervised			
Exercises and problem solving	67	2.68	1, 3, 4, 5, 7, 8, 9
Type: Autonomous			
Individual work of theoretical concepts	70	2.8	2, 3, 4, 5, 7, 8, 9

Master classes to facilitate the learning of the basic concepts of the contents, that can be found in the bibliography.

Classes of problems to solve exercises and problems related to the subject exposed in the master classes.

Tutorials to solve the specific doubts that arise in the individual study of the subject and in the learning of the specific competences of the subject as well as in the transversal skills.

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Individual written tests	10 points	5	0.2	1, 2, 3, 4, 5, 6, 7, 8, 9

Paper to submit	1 point	5	0.2	3, 4, 5, 6, 7, 8, 9
Resit exam	10 points	3	0.12	1, 2, 3, 4, 5, 6, 7, 8, 9

a) Scheduled evaluation process and activities
Individual written examinations, on questions of theory and problems, about 45 min. of duration, they will be after chapters 1, 2-3, 4-5, 6-7 (maximum 10 points).
The score of each of the four tests will be: test 1 (1 point); test 2-3 (3 points); test 4-5 (3 points), and test 6-7 (3 points).

If due to exceptional causes and duly justified with documents, someone can not attend a scheduled activity, it can be done on the day of the recovery exam. The documents, which justify the absence in the test, must be submitted as soon as possible.

A paper to submit, chosen from a list (maximum 1 point).

All scores will be added, P, without any minimum grade requirement. To succeed, you must have a score equal to or greater than 5.
If P is smaller or equal to 9, the final grade will be P; if P is greater than 9, the final grade will be P- (P-9) / 2.

b) Programming evaluation activities
The dates of the evaluation activities will be given on the first day of class of the course and will be made public through the Campus Virtual.

c) Recovery process
There will be a written synthesis exam of the whole subject with a maximum of 10 points, the day that the Engineering School sets.

The student can apply for resit whenever he has submitted to a set of activities that represent at least two thirds of the total grade of the subject.
Of these, students who have written scores higher than 2 may be presented in the recovery.
d) Procedure for review of qualifications
For each evaluation activity, a place, date and time of review in which the student can review the activity with the teacher will be indicated. In this context, claims may be made on the note of the activity, which will be evaluated by the teaching staff responsible for the subject. If the student does not submit to this review, this activity will not be reviewed later.

e) Special qualifications
Anyone who only presents to 3 or less continuous assessment tests, and does not attend the recovery exam, will have a final grade of "Not gradable".

Degree with Honors (MH)
The regulations of the UAB indicate that the MH can only be granted to studentswho have obtained a final grade equal to or greater than 9,0. It can be granted up to 5% MH of the total number of students enrolled. With this regulation, the teaching staff of the subject will award the honor grade in accordance with the evaluation tests and the class participation of the candidate students.
f) Irregularities by the student, copy and plagiarism
Without prejudice to other disciplinary measures deemed appropriate, will be scored with a zero the irregularities committed by the student that may lead to a variation in the grade of an act of evaluation. Therefore, copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending with a zero. Evaluation activities qualified in this way and by this procedure they will not be recoverable, therefore, the maximum score of the non-recoverable test will be subtracted from the maximum score of the recovery exam (10 points).

g) Evaluation of repeating students
From the second enrollment, to submit to the recovery exam will not require a minimum score of 2 points or have submitted to a minimum ofcontinuous assessment tests.

h) Single assesment (evaluation)
Students who have accepted the single assessment modality will have to take a final test which will consist of a theory exam, where they will have to answer a series of short questions referring to the entire course syllabus. Next, they will have to do a second test where they will have to solve a series of exercises similar to those worked on in the Classroom Practice sessions. Finally, they will defend a short presentation (about 10 minutes) on one of the topics from the list of optional issues published at the beginning of the course on the Virtual Campus. These tests will take place on the same day, time and place as the last test of the continuous evaluation modality.

The student's grade will be the weighted average of the three previous activities, where the theory exam will account for 30% of the grade, the problem exam 40% and the defense of the short oral presentation 10%.

If the final grade does not reach the score of 5, the student has another opportunity to pass the subject through the remedial exam that will be held on the date set by the degree coordinator. The grade obtained in this exam will be the final grade for the subject.

Bibliography

Theory books:

1. J. Costa Quintana y F. López Aguilar, Interacción electromagnética. Teoría clásica, (Reverté 2007). ISBN: 978-84-291-3058-4.
2. D.J. Griffiths, *Introduction to Electrodynamics, Fourth Edition*, (Cambridge, 2017). ISBN: 978-1-108-42041-9.
3. P. Lorrain y D.R. Corson, Campos y Ondas Electromagnéticos, (Selecciones Científicas, 1990). ISBN: 84-85021-29-0.
4. J. R. Reitz, F. J. Milford, y R. W. Christy, Fundamentos de la Teoría Electromagnética, (Addison-Wesley Iberoamericana, 1996). ISBN: 0-201-62592-X.
5. P.A Tipler y G. Mosca, Física para la ciencia y tecnología. 6 Edición, (Reverté, 2010).ISBN: a 978-84-291-4428-4)
6. R. K. Wangsness, Electromagnetic fields, (John Wiley & Sons, 1986, 2nd edition) ISBN: 0-471-81186-6; Campos electromagnéticos, (Limusa, 1989). ISBN: 968-18-1316-2.
7. H.D. Young y R.A. Freedman, Física Universitaria, Vol. 1, 12a Edición, (Addison Wesley-Pearson Educación, 2009) ISBN: 978-607-442-288-7.

Problems books:

1. E. Benito; Problemas de campos electromagnéticos, (AC, 1984); ISBN: 84-7288-007-9.
2. J.A. Edminister; Electromagnetismo, (McGraw-Hill, 1992); ISBN: 970-10-0256-3.
3. F. Gascón Latasa et al., Electricidad y Magnetismo, (Pearson, 2004); ISBN: 84-205-4214-8.
4. J.M. De Juana Sardón y M.A. Herrero García, Electromagnetismo, (Paraninfo 1993); ISBN: 84-283-1992-8.
5. E. López Pérez y F. Núñez Cubero, 100 problemas de electromagnetismo, (Alianza Editorial, 1997); ISBN: 84-206-8635-2.

Software

occasional use of educational applets in Mathematica

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	311	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	312	Spanish	second semester	morning-mixed
(PAUL) Classroom practices	331	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	332	Spanish	second semester	morning-mixed
(PAUL) Classroom practices	351	Catalan	second semester	afternoon
(PAUL) Classroom practices	352	Spanish	second semester	afternoon
(TE) Theory	31	Catalan	second semester	morning-mixed
(TE) Theory	33	Catalan	second semester	morning-mixed
(TE) Theory	35	Catalan	second semester	afternoon