

**Foundations of Physics**

Code: 102707  
ECTS Credits: 9

Degree	Type	Year	Semester
2500895 Electronic Engineering for Telecommunication	FB	1	2
2500898 Telecommunication Systems Engineering	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

**Contact**

Name: Angel Lizana Tutusaus  
Email: Angel.Lizana@uab.cat

**Use of Languages**

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: Yes

**Other comments on languages**

The theory classes of groups 31 and 33 will be done in Catalan and those of group 35 in Spanish.

**Teachers**

Josep Gutiérrez Martínez  
Angel Lizana Tutusaus

**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 engineers 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 engineers 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.

## Methodology

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.

## Activities

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, 4, 3, 5, 7, 8, 9
Type: Autonomous			
Individual work of theoretical concepts	70	2.8	2, 4, 3, 5, 7, 8, 9

## Assessment

### 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 five tests will be: test 1 (1 point); test 2 (1.5 points); test 3 (1.5 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 students who 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 of continuous assessment tests.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Individual written tests	10 points	5	0.2	1, 2, 4, 3, 5, 6, 7, 8, 9
Paper to submit	1 point	5	0.2	4, 3, 5, 6, 7, 8, 9
Resit exam	10 points	3	0.12	1, 2, 4, 3, 5, 6, 7, 8, 9

## 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 Electromagnéticas, (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