Universidad de Alcalá

TEACHING GUIDE

Fundamentals of Physics I

Degree in
Telecommunication Technologies Engineering (GITT)
Telecommunication Systems Engineering (GIST)
Telematics Engineering (GIT)
Electronic Communications Engineering (GIEC)

Universidad de Alcalá

Academic Year 2025/2026

1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Fundamentals of Physics I**
Code:	**350002 (GITT+GIST+GIT+GIEC)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)** **Telematics Engineering (GIT)** **Electronic Communications Engineering (GIEC)**
Department and area:	**Física y Matemáticas** **All in Teaching Unit of Physics**
Type:	**Basic (GITT+GIST+GIT+GIEC)**
ECTS Credits:	**6.0**
Year and semester:	**1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)**
Teachers:	Dra. Consuelo Cid Tortuero
Tutoring schedule:	To be defined
Language:	English

1. COURSE SUMMARY

Fundamentals of Physics I is a basic subject which goal is to establish the scientific background for the development of the knowledge and understanding of the telecommunication technology. The contents of this subject are though as a continuation of those from the High School, but taught using a more formal Physical and Mathematical treatment as an ability needed for other subjects of higher courses.

This subject offers a detailed study of physical phenomena involved in the electric and magnetic phenomena, which settle the bases to understand the electromagnetic field in Fundamentals of Physics II. Both subjects are complementary to achieve fundamental concepts needed for the training in other more technological subjects taught in this Degree.

The subject starts dealing with the general conservation principles of momentum and energy applied to a particle system. Electric and Magnetic Fields are covered in the rest of the subject. Electric field is studied both in vacuum and in matter (including conductors and dielectrics) from a static perspective. Applications through exercises of different tools, as the Gauss's law, will help to understand physical concepts. Last topic is devoted to magnetic field, including an introduction to electric current and moving charges and currents feeling magnetic force, with applications as the electric engine and equilibrium under electric and magnetic field.

Prerequisites and Recommendations

The course assumes a good working knowledge of Physics and Mathematics at a higher secondary school level upon entering the course

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU4 - Autonomous learning skills.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CB3 - Understanding and knowledge of basic issues related to the general laws of Mechanics, Thermodynamics, Electromagnetic Fields and Waves and developing the ability to find solutions to engineering problems.

Learning outcomes:

On successful completion of the subject students will be able to:

RA1. Knowledge and understanding of terminology applied to Mechanics and Electromagnetism, and dimensional analysis.

RA2. Competency in using the essential mathematical skills needed for describing Mechanic and Electromagnetic phenomena.

RA3. Problem solving skills applied to conservation of momentum and energy.

RA4. Problem solving skills applied to Electrostatics including conductors and dielectrics.

RA5. Problem solving skills applied to Magnetostatics including forces and torques.

RA6. Laboratory-based competency in electromagnetism.

3. CONTENTS

Theoretical Contents:

Topic 1. Elementary Mechanics. Units and dimensions. Mathematical Notes. Newton's Laws of motion. Conservation of Linear and Angular Momentum. Conservation of Energy. Work. Conservative forces. Forces and equations of motion: some examples. Extending previous concepts: Scalar and Vector Fields; Conservative Fields, Circulation of Vector Fields. Many particle systems and energy: work and heat. The Laws of Thermodynamics.

Topic 2. Static Electric Field in Vacuum. Coulomb's Law, The Electric Field and Potential: Point Charges and Charge Distributions. Electric flux: Gauss's Law. Applications of Gauss's Law to compute Electric Field in Symmetrical Charge Distributions.

Topic 3. Electric Fields in Matter: Conductors. Conductors. Features and Properties of conductors in Electrostatic Equilibrium. Gauss's Law applied to Conductors in Electrostatic Equilibrium. Conductors subject to an external Field. Cavities: electric shielding. Connection of conductors: sharp points effect. Ground connection. Capacitors.

Topic 4. Electric Fields in Matter: Dielectrics. Electric dipole: dipole moment. Electric field and potential due to an electric dipole. Electric dipole in an electric field. Dielectrics in Electric Fields: Polarization. Linear dielectrics. Material Polarization and Bound Charge Densities. Dielectrics filling a capacitor. The Electric Displacement Field: Gauss's Law in Dielectrics. Electrostatic Energy in Charge Distributions and Electric Field Energy Density. Applications of Electrostatics for Engineering

Topic 5. Magnetic Field in Vacuum. I. Current and current density. The continuity equation. Ohm's Law. The Magnetic Field. Moving Charges Feel Magnetic Force: Lorentz Force. Currents exposed to a magnetic field: Forces and Torques. Magnetic moment. Equilibrium under the presence of Electric and Magnetic Fields.

Experimental Contents:

A set of laboratory experiences dealing on methodologies and techniques of measurement commonly used in Physics. These experiments focus on different physical aspects developed in the subject.

Each student will complete 6 hours in the Physics laboratory scheduled, including a seminar on uncertainties and graphs.

Units (Topics)	Total number of hours
Introduction to Mechanics (Topic 1)	15 hours
The Electric Field (Topics 2-4)	33 hours
The Magnetic Field (Topic 5)	8 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	56 hours (including traditional lectures, training lectures and laboratory classes) + 2 hours exam
Number of hours of student work:	92 hours (including homework, own-study, online activities and exams preparation)
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The methodology of this course is as follows:

Traditional Lectures. Lectures to communicate the main theoretical contents of every Topic.

Training Lectures. Active lectures devoted to identifying the physical concepts involved in practical problems related to the theoretical concepts explained. It will be emphasized the appropriate methodology to understand the phenomena involved, to distinguish between essential and accessory inputs, to analyse the procedure and to wonder about the validity of the obtained results.

Laboratory lectures. Active lectures at Physics laboratory in small groups where the students will acquire skills to handle different equipment and laboratory instruments, learning to handle experimental data, to check physical laws and to get relevant magnitudes. Laboratory experiences will be complementary to theoretical and training lectures. A script will be provided for the students before the lecture and they will develop the laboratory experience under the supervision and with the help of the Professor. The student shall draw up a report with the results derived from the experience made.

Tutorials. During the tutorials, the student work will be guided by the Professors, who will solve / advise on matters arising during the course and will guide the student on the literature and methodology appropriate to address the issues raised.

The tools used will be:

Traditional lectures	Theoretical lectures using blackboard, slides, web resources and java applets
Training lectures and seminars	Lectures where physics problems and theoretical questions will be solved with active participation of the students, which are encouraged to ask questions and to propose solutions
Laboratory experiences	Laboratory experiences following a script and being guided by a Professor
On-line activities and tutorials	Students will attend one group tutorial per two weeks. Training activities, forum participation and other activities at UAH virtual classroom using Blackboard platform will be recommended if necessary.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call:

1. **Continuous evaluation:** Students will be asked to take two partial exams and two laboratory experiences. This is the default option. Students who fail the first partial exam will have the opportunity to resit the exam of the corresponding competences. This re-sit first-partial exam, as well as the second partial exam, will be carried out in the date of the final exam. Students who fail to attend the second partial exam will be marked as NP (Not attending).
2. **Final exam evaluation:** Students will have to pass a final exam. Should a student not be able to follow continuous assessment, he/she will have to ask to be grated evaluation by final exam according to the University regulations. Should a student do not take the final exam will be marked as NP (Not attending).

Extraordinary Call:

Students will have to pass a final exam. Should a student not take the final exam will be marked as NP (Not attending).

5.2. EVALUATION

Evaluation criteria:

CE1. Knowledge of main physical principia included in the contents of the subject, and of the magnitudes and parameters involved and their value ranges.

CE2. Ability to identify those physical principia in a variety of situations and processes, applying them for diagnosis and forecasting in case-studies, both qualitatively and using the mathematical expressions of the discipline.

CE3. Ability to relate different topics of the subject to solve problems involving scientific and technological aspects.

CE4. Ability to discuss topics at length and to make meaning clear.

CE5. Appropriateness of scientific-technological terminology used, including the suitability of symbols and units for the magnitudes and parameters involved in the subject.

CE6. Self-involvement and awareness of the processes involved in the skills of this subject, shown in the appropriateness of the deliverables, including exams, laboratory experiences and other tasks,

being responsible for completing assignments on time, and in the class attendance and participation.

Grading tools:

This section describes the assessment tools, which will be applied for every Assessment Criteria:

i. To take two Partial Assessment Exams (**PEI 1-2**). The first partial exam, **PEI1**, will be taken at midterm semester, and the second one, **PEI2**, will be carried out in the date of the final exam. Both exams will include solving problems and/or questions concerning the Topics 1-5.
ii. To take a Final Exam (**PEF**): In the date established for the final exam, students will find the possibility to improve previous marks obtained in **PEI1**, in addition to taking the second partial exam **PEI2**. In order to resit **PEI1**, the student must not necessarily attend the first call. Students granted evaluation by final exam will take two partial exams (resitting **PEI1**, and **PEI2**) in the final exam date.
iii. To deliver two laboratory reports (**PL 1-2**, **both student following continuous assessment and those granted by final exam**). Students will deliver a report with the results derived from every laboratory experience made (**EL 1-2**).
iv. Extraordinary Call Exam (**PCE**): It consists on an exam covering all skills in the subject.

Mark procedure:

This Section quantifies the Assessment Criteria to pass the subject.

Ordinary Call, Continuous Assessment:

Skills	Learning Outcomes	Evaluation criteria	Assessment Tool	Marking criteria
TR2, TRU1, TRU2, TRU4, CB3	RA1, RA2, RA3, RA4	CE1-CE6	PEI1 (PEF)	40%
TR2, TRU1, TRU2, TRU4, CB3	RA1, RA2, RA4, RA5	CE1-CE6	PEI2 (PEF)	40%
TRU2, TRU4, CB3	RA1, RA2, RA6	CE1-CE6	PL1-2, EL1-2	20%

The final grade of the students depends on their performance in partial exams (40% each) and their performance in the laboratory (20%). Laboratory experiences are not compulsory, but if a student misses the laboratory classes his/her performance in the laboratory will be zero. In order to pass the subject, students will have to have obtained a pass mark equal or larger to five out of 10.

As stated above, students will have the opportunity to resit the first partial exam (**PEI1**) in the date of the final exam (**PEF**). Students who take this resitting exam will always have as definitive marks those of the re-sit exam.

Ordinary Call, Final Assessment:

Competence	Skill	Assessment criteria	Assessment Tool	Marking criteria
TR2, TRU1, TRU2, TRU4, CB3	RA1-RA5	CE1-CE6	PEF (PEI1-2)	80%
TRU2, TRU4, CB3	RA1, RA2, RA6	CE1-CE6	PL1-2, EL1-2	20%

The final grade of the students depends in this case on their performance in a re-sit exam (80%), which will consist in two exams, corresponding to the two partial exams, in the date assigned to the **PEF**. The

other 20% of the final grade depend on their laboratory performance. As stated above, laboratory experiences are not compulsory, but if a student misses the laboratory classes his/her performance in the laboratory will be zero. In order to pass the subject, students will have to have obtained a pass mark equal or larger to five out of 10.

Extraordinary call:

Competence	Skill	Assessment criteria	Assessment Tool	Marking criteria
TR2, TRU1, TRU2, TRU4, CB3	RA1-RA6	CE1-CE6	PCE	100% (80%)

The final grade of the students in the extraordinary call will depend on their performance in the re-sit exam (100%), which may include an element related to laboratory experiences. Nevertheless, the student can ask to keep his/her previous laboratory performance (20%) and to consider his/her performance in the re-sit exam as 80% of the final grade. Should a student do not take the final exam will not be marked.

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

Basic Bibliography

- J. M. De Juana, Física General, Vols I y II, Ed. Pearson Prentice Hall, 2ª edic. (2007)
- M. Alonso, E. J. Finn, Física, Ed. Addison Wesley Iberoamericana (1995)
- W. H. Hayt, J. A. Buck, Teoría electromagnética, McGrawHill, 6ª edición (2006)
- Sears, Zemansky, Young, Fredman, Física Universitaria. Vols I y II, Ed. Pearson. Addison Wesley, 11ª edición (2004)
- R. A. Serway, J. W. Jewett, Física, Ed. Thomson, 3ª edición (2003)
- P. A Tipler, Física, Ed Reverté,
- P.A. Tipler / Mosca, Física, (Vol 1a), (5ª edición).ED. Reverté
- R. K. Wangsness, Campos electromagnéticos, Ed. Limusa (1996)
- Álvarez-Ude, González, Raposo, Fundamentos de Campos Electromagnéticos y Ondas): Ejercicios y problemas resueltos de Física, ED. FEBCCS (2012)
- Jearl Wlaker, Halliday - Resnick, Fundamentals of Physics, Ed. Wiley, 8ª edic. (2008)
- Feynmann, Física, Vol II, Ed. Adisson Wesley Iberoamericana
- Berkeley Physics Course, Vol 2 Electricidad y magnetismo, Ed. Reverté
- J. D. Kraus, D. A. Fleisch, Electromagnetismo con aplicaciones, Ed. McGrawHill, 5ª edición (2000)

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.