Universidad de Alcalá

TEACHING GUIDE

Fundamentals of Physics II

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

Universidad de Alcalá

Academic Year 2021/2022

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

Approved by the School Board on July 6, 2021

TEACHING GUIDE

Course Name:	**Fundamentals of Physics II**
Code:	**350008 (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:	**2nd Year - 1st Semester (GITT+GIST+GIT+GIEC)**
Teachers:	Dr. Antonio Guerrero Ortega
Tutoring schedule:	To be defined
Language:	English

1. COURSE SUMMARY

Fundamentals of Physics II 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 Fundamentals of Physics I, which is taught during the first semester of the first course. Along both subjects, a general study of physical phenomena involved in the understanding of electromagnetic field is presented and fundamental concepts needed for the training in other more technological subjects taught in this degree are established.

The subject starts dealing with the different performances of the matter under the presence of an external magnetic field and follows on with the study of the laws for the phenomena related to time-variable fields. General properties of waves are studied as an introduction to be followed by a detailed analysis of electromagnetic waves. Last topics are devoted to study different wave phenomena, and in particular to electromagnetic waves. Finally, light is analysed considering the geometrical optics approach.

Prerequisites and Recommendations

The course assumes a good working knowledge of Fundamentals of Physics I, Calculus I and Linear Algebra 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.

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:

- **RA1: Understanding and knowledge**

To define, to show and to explain the scientific concepts and the most relevant physical-mathematical models concerning Information and Communication Technologies (ICT) and the approaches and simplifications commonly applied. Among them, the following ones can be highlighted:

1. To define the magnetic flux and its temporal variation. To understand Faraday's Law and Lentz's Law.
2. To determine the magnetic properties of material media
3. To describe the displacement current introduced by Maxwell, and to extent the Electromagnetic equations to the definitive formulation.

4. To discuss the solutions of the wave equations of electric and magnetic fields: travelling and standing waves; the associated phenomena of reflection, refraction, diffraction and polarization.

- **RA2: Engineering analysis**

To draw up, to analyse and to solve problems related to previous concepts. It can be highlighted:

1. Applications of the electromagnetic induction laws.
2. To use the magnetism in material media to solve highly symmetric systems.
3. To identify and to understand basic and general electromagnetic systems.
4. To appreciate the properties of electromagnetic waves, specifically the visible and microwaves spectral regions.

- **RA3: Research and innovation**

To manipulate different equipment and instruments in the laboratory experiences, which are specifically designed to illustrate and to calculate parameters related to the induction concepts and the electromagnetic properties.

- **RA4: Engineering experience**

To know the limits of validity of the theories and models included in this subject.

3. CONTENTS

Theoretical Contents:

Topic 1. The Magnetic Field in vacuum (continuation). Biot-Savart Law: applications. Ampere's Law: applications.

Topic 2. Magnetic induction: Faraday's Law. Induced electromagnetic force: Faraday experiences. Faraday's law. Mutual inductance and autoinductance. Currents after switches are closed or opened in circuits. Magnetic energy density in a circuit.

Topic 3. The Magnetic Field in matter. Magnetisation phenomena. The magnetization vector and linear magnetized media. Magnetic field H. Ampere's law in magnetic materials. Stored energy in magnetic matter. Diamagnetism, paramagnetism and ferromagnetism. Applications.

Topic 4. The general theory of electromagnetism. Displacement current. Maxwell's equations (macroscopic form and microscopic one). Boundary conditions. Electromagnetic field energy: the Poynting's vector and the propagation of energyTheorem.

Topic 5. Waves: basic concepts. The Physics of vibrations and waves. Kinds of waves. Equation of a wave. Harmonic functions: features. Energy and intensity of a one-dimensional monochromatic wave. Attenuation in intensity and amplitude: geometrical factors and dissipative materials. Non-monochromatic waves: phase and group velocities: dispersive materials.

Topic 6. Electromagnetic waves. Wave equations for electric and magnetic field. Propagation of plane electromagnetic waves in matter: features. Energy flow in electromagnetic waves. The electromagnetic spectrum.

Topic 7. Waves: properties. Reflection and transmission phenomena: Snell's laws. Total internal reflection: applications. Interference phenomenon. The two-slit interference pattern. Several coherent light sources interference pattern. Interference in Thin Films. Stationary waves. Diffraction phenomenon. Polarization phenomenon. Malus' law. Applications.

Topic 8. Geometrical optics. Geometrical optics approach. Geometrical optics elements. Images formed by reflexion: plane and spherical mirrors. Images formed by refraction. Lenses. Images formed by a set of thin lenses.

Experimental Contents:

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

Each student will complete 6 hours in the Physics laboratory scheduled in three experiences of two hours long each.

Units (Topics)	Total number of hours
Variable fields (Topics 1-3)	24 hours
Waves (Topics 4-7)	30 hours
Geometrical optics (Topic 8)	2 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (including 56h for traditional lectures, training lectures, seminars and laboratory classes and one 2h 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 methodologies of this course are 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 (Regulations for the Regulation of Teaching Learning Processes, NRPEA, 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 Regulations for the Evaluation of Apprenticeships (approved by the Governing Council on March 24, 2011 and modified in the Board of Directors). Government of May 5, 2016) 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 three laboratory experiences. This is the default option. Students who fail the first partial exam will be asked to take the re-sit exam of the corresponding competences. The date of the second partial exam, as that of the re-sit exam of the first partial, will be the date of the final exam. Should a student do not take the second partial exam will not be marked.
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 not be marked.

Extraordinary Call:

Students will have to pass a final exam. Should a student not take the final exam will not be marked.

In any procedure, in order to pass the subject, students will have to have obtained a mark of 5 out of 10.

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 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). PEI1 will be taken at midterm semester and PEI2 will be taken the date of the final exam. They will include solving problems and/or questions concerning the Topics of the subject.
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 PEI 1, and to take the second partial exam. Students not attending to PEI1 at the due date, are allowed to take re-sit PEI1 at the date of the final exam. Students granted evaluation by final exam will take two partial exams in the final exam date (re-sit PEI1 and PEI 2).
iii. To deliver three laboratory reports (PL 1-2-3, 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 (E 1-2-3).
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	Grading Tool	Contribution to the final mark
TR2, TRU1, CB3	RA1 (1,2,3), RA2 (1,2,3) RA4	CE1-CE6	PEI 1 (PEF)	40%
TR2, TRU1, CB3	RA1 (4), RA2 (4), RA4	CE1-CE6	PEI 2 (PEF)	40%
TR2, TRU1, CB3	RA3, RA4	CE1-CE6	PL1-2-3, E1-2-3	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.

In the final exam (PEF), as explained above, students have the possibility to obtain a new mark in PEI 1. Students who take the re-sit exam of PEI 1 will be marked with their marks obtained in the re-sit exam.

Ordinary Call, Final Assessment:

Skills	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TRU1, CB3	RA1, RA2, RA4	CE1-CE6	PEF (PEI 1-2)	80%
TR2, TRU1, CB3	RA3, RA4	CE1-CE6	PL1-2-3, E1-2-3	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

Skills	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TRU1, CB3	RA1, RA2, RA3, RA4	CE1-CE6	PCE	100%

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.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

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- P.A. Tipler, G. Mosca, Física, (Vol. 1a), Ed. Reverté (5ª ed.) (2005)
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- R. K. Wangsness, Campos electromagnéticos, Ed. Limusa (1996)
- M. A. Raposo, E. González, J. Alvarez-Ude, Fundamentos de campos electromagnéticos y ondas. Ejercicios y problemas resueltos de física. Ed. FEBCCS (2012)

6.2. Additional Bibliography

- R. Feynman, R. B. Leighton, M. Sands, Física, Vol II: Electromagnetismo y materia, Ed. Adisson Wesley Iberoamericana (1998)
- E. M. Purcell, Electricidad y Magnetismo, Berkeley Physics Course – Vol II, Ed. Reverté (1994)
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Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.