Course guide
205263 - AF - Advanced Physics

Last modified: 17/07/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Pons Rivero, Antonio Javier

Others: Mudarra Lopez, Miguel
Jimenez Buendia, Ricardo Abraham
Torre, Iacopo
Algunes classes o grups de l'assignatura es faran en català i algunes en castellà. Consulteu l'horari per saber l'idioma concret de cada grup/classe.

PRIOR SKILLS

Basic Knowledge in Physics and Mathematics corresponding to Physics I, Physics II, Calculus I, Algebra and Calculus II subjects

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE02-INDUS. Understanding and mastery of the basic concepts of the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and their application to the resolution of engineering problems. (Basic training module)

TEACHING METHODOLOGY

Theory sessions and classes of problems:
The classes of theory will be in the classroom, with all group simultaneously. It will consist on explanatory classes and of synthesis, where the concepts and examples of applications will be presented.
During these classes, some key experiments will also be done to motivate some concepts.
The techniques to solve exercises in the classes of problems will be presented.
In the practice sessions the students will do qualitative and quantitative studies of the electromagnetic phenomena. These practices sessions will have two hours of duration, every two weeks.
The continuity of the content of these classes will be emphasized by relating theory, practical situations and problems done in each class.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of this course is that the student acquire basic knowledge of the electromagnetic theory, in vacuum and in the matter, as well as their applications in the different fields of interest for engineering.

STUDY LOAD

Type	Hours	Percentage
Hours large group	32,0	21.33
Hours medium group	14,0	9.33
Hours small group	14,0	9.33
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1 Electrostatics in vacuum

Description:
The electric charge. Coulomb's law. Principle of superposition. Electric Field. Continuous charge distributions. Gauss's law. Electrostatic potential. Poisson and Laplace equations. Work and electrostatic potential energy.

Full-or-part-time: 25h
Theory classes: 8h
Practical classes: 4h
Laboratory classes: 2h
Self study : 11h

2 Electrostatics with conductors. Capacity

Description:
Isolated conductor. Capacity. Conductor subjected to an external field. Electrostatic influence. Shielding. Faraday cage. Applications. Capacitors. Types. Stored energy.

Full-or-part-time: 21h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 13h

3 Electrostatics in dielectric matter

Description:
Electric dipole. Field created by and forces on the dipole. Types of dielectric materials. Magnitudes used: Polarization, polarization charges, Electric displacement. Action of the electric field on a dielectric. Regimes: linear, dielectric breakdown. Capacitors with dielectric media. Energy. Generalized Gauss's Law.

Full-or-part-time: 8h 30m
Theory classes: 2h
Practical classes: 1h
Self study : 5h 30m

4 Electrocinetics

Description:
Types of electric current. Intensity and density of current. Continuity equation. Direct current in materials: Conductivity and electrical mobility. Physical interpretation. Ohm's Law. Electrical resistance. Association of resistors. Energy dissipation. Joule's law. Generators. Electromotive force. Kirchhoff's laws.

Full-or-part-time: 22h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 14h

5 Magnetostatics

Description:
Forces between stationary currents: Ampère's law. Magnetic field: law of Biot and Savart. Force associated with the magnetic field. Magnetic field and magnetic force in basic configurations: rectilinear conductors, coils and solenoids. Magnetic dipole moment. Ampère's law. Vector potential. Lorentz force (on free charges). Application examples. synchrotron

Full-or-part-time: 21h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 13h

6 Electromagnetic induction

Description:
Henry-Faraday's law. Lenz's law. Induction by variation of the magnetic field in time. Self inductance, mutual inductance. Magnetic energy. Alternating current generation. Eddy currents. Relationship between energy and magnetic force.

Full-or-part-time: 16h
Theory classes: 4h
Practical classes: 2h
Self study : 10h

7 Magnetism in matter

Description:
Origin of magnetism in materials. Magnetization. Equivalent current densities. Field of magnetic intensity H. Generalization of Ampère's law. Magnetic susceptibility and permeability. Diamagnetic, paramagnetic and ferromagnetic materials. Response to magnetic fields. Hysteresis cycle. Magnetic energy. Aplications.

Full-or-part-time: 13h 30m
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 2h
Self study : 8h 30m

8 Electrodynamics

Description:
RC circuit: charging and discharging the capacitor. RL circuit: connection and disconnection transients. LC circuit: oscillators. RLC circuit without generator. Alternating current: Series RLC circuit connected to an alternating generator. Reactance, impedance. Phase differences between current and voltages. Moving from real notation to phasors and complex notation. Power. Power factor. Resonance

Full-or-part-time: 12h
Theory classes: 2h
Laboratory classes: 2h
Self study : 8h

9 Equations of Maxwell and electromagnetic waves

Description:
Electric induction. Displacement current. Maxwell's equations. Wave equation. Electromagnetic waves.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 2h
Self study : 7h

ACTIVITIES

EXERCISE CLASSES

Description:
Prior and subsequent preparation of practical and problem sessions and attendance at these.

Material:
Exercises on the Atenea platform.
Book of problems for the subject (in ATENEA).

Full-or-part-time: 29h
Practical classes: 14h
Self study: 15h

THEORY CLASSES

Description:
Prior and subsequent preparation of the theory sessions and attendance at these

Specific objectives:
Acquire the necessary knowledge for a correct interpretation of the contents. Preparation for the theoretical and practical part of the subject exams.
Resolution of doubts in relation to the syllabus of the subject.

Material:
Notes and transparencies on the Atenea platform.
General bibliography of the subject.

Full-or-part-time: 59h
Self study: 30h
Theory classes: 29h

LABORATORY PRACTICE

Description:
The subject of Physics Extension has, as one of its characteristic features, the realization of laboratory practices. These practices will be carried out in the Physics Laboratory, in teams of two, in two-hour sessions. Before the session in the laboratory, the students must have previously read the script and written a summary of the practice, in order for the students to identify the motivation, the objectives, the necessary material, the method experimental and the expected results in the experiment. In the Laboratory, the groups take the data, and do an initial treatment of it, to see the consistency of their results. Afterwards, they will prepare a report on the practice carried out, which will include tables, graphs and calculation of errors. Finally, there will be a laboratory exam.

Material:
The necessary material will be found in the Laboratory. Practice scripts are available at ATENEA.

Delivery:
Summary of the practice carried out before the session.
Report of the practice carried out after the session in the laboratory.

Full-or-part-time: 29h
Self study: 15h
Laboratory classes: 14h

4.- EVALUATION TESTS

Description:
Assessment tests will be carried out for:
-Knowledge of contents,
-Ability to solve practical problems, either new or based on practices carried out in the laboratory.
More details are given in the "Qualification System" section. In particular, it is specified that there will be a partial exam and a final exam, among other assessment acts.

Delivery:
Completion of the test and delivery of what has been written, if applicable.

Full-or-part-time: 33h
Self study: 30h
Theory classes: 3h

GRADING SYSTEM

There will be two scheduled exams: a partial exam on the topics of electricity (contents 1 to 4; activities 1, 2) and a final exam on the topics of Magnetism (contents 5 to 9; activities 1, 2). These exams will have a theoretical-practical nature, that is, they will contain both theory questions and problems.
The students will carry out and must also deliver a series of laboratory practices and practical exercises in the scheduled practice classes, which will be taken into account for the evaluation. Attendance at practice sessions and handing in practical assignments is a prerequisite for passing the subject. A test can also be taken to assess the student's progress in the laboratory.
The overall grade NG for the subject will be calculated according to the following equation:
NG= 0.40 NP + 0.40 NF + 0.10 NL + 0.10 NC
NG : overall grade
NP : partial exam grade
NF: final exam grade
NL: laboratory grade
NC: continuous activity grade

The NC grade may be based mainly on one or two tests and/or exercises collected throughout the course.
The NL grade may be based mainly on the laboratory reports and/or a laboratory exam. The teachers of the subject will establish this at the beginning of each semester.
The renewal mechanism will be a new examination. All those students who fail, want to improve their grade or cannot attend the partial exam, will have the opportunity to take the exam on the same day as the final exam. The renewal mechanism will be graded between 0 and 10. The grade of the renewal exam will only replace that of the partial exam if it is higher.

BIBLIOGRAPHY

Basic:
- Sadiku, Matthew N. O. Elementos de electromagnetismo. 3a ed. México: Oxford Univeristy Press, 2003. ISBN 970613672X.
- Cheng, David K. Fundamentos de electromagnetismo para ingeniería. Wilmington: Addison-Wesley Iberoamericana, 1997. ISBN 9684443277.
- Tipler, Paul Allen; Mosca, Gene. Física per a la ciència i la tecnologia, vol. 2 [on line]. Barcelona [etc.]: Reverté, 2010 [Consultation: 17/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5758259. ISBN 9788429144338.

Complementary:
- Plonus, Martin A. Electromagnetismo aplicado. Barcelona: Reverté, 1982. ISBN 8429130632.
- Wangsness, Roald K. Campos electromagnéticos. México: Limusa, 1983. ISBN 9681813162.

RESOURCES

Hyperlink:
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http://atenea.upc.edu. Recull de problemes de l'assignatura, exàmnes resolts i guions per a la realització de les práctiques