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230457 - FIS2 - Physics 2

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Sese Castel, Gemma

Others: Alonso Maleta, Maria Aranzazu
Mercader Calvo, Maria Isabel

Opening hours

Timetable: By appointment

Degree competences to which the subject contributes

Specific:

2. Ability to solve basic problems in mechanics, elasticity, thermodynamics, fluids, waves, electromagnetism and modern physics, and its application in solving engineering problems.
1. Knowledge of the scientific method and its applications in physics and engineering. Ability to formulate hypotheses and make critical analysis of scientific problems in the field of physics and engineering. Ability to relate the physical reality with their mathematical models and vice versa.

Generical:

3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
2. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Teaching methodology

*Workload in the classroom: 2.6 ECTS
Development of both theoretical and active practical classes. Practical tasks made individually or within a team. Tutorial activities.
*Workload outside the stablished timetable: 3.4 ECTS
Development of problems, and of theoretical or practical projects, which will be evaluated.

Learning objectives of the subject

The student must be able to analyze physical phenomena involving the basic concepts related to waves and electromagnetism, both qualitatively and quantitaively.

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Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

Content

Waves	Learning time: 30h 30m Theory classes: 7h Practical classes: 5h Guided activities: 0h 30m Self study : 18h

Description:
In this chapter we study wave motion and its mathematical description. We start with the analysis of waves along a string. The wave equation is demostrated, and sinusoidal waves are presented. Energy transfer for waves in a string is studied, and it is generalized for mechanical waves in two and three dimensions. Wave intensity is defined. Sound waves are studied, as well as the Doppler effect. The final part of the chapter is devoted to the analysis of phenomena related to the interference of waves. Properties of standing waves are also studied.

Static electric field. Potential and energy.	Learning time: 36h 30m Theory classes: 10h Practical classes: 6h Guided activities: 0h 30m Self study : 20h

Description:
The chapter is aimed at the study of electric fields created by charges at rest, both point charges and continuous charge distributions. Electric fields are evaluated by using Coulomb's law and, if symmetry permits, by using Gauss' law. Given the fact that electrostatic forces are conservative, it is possible to evaluate the potential energy associated to an electric field and to relate this quantity to the electric potential. To this end, the concepts of gradient and circulation are revisited.

Conductors. Electric current.	Learning time: 25h Theory classes: 6h Practical classes: 4h Guided activities: 1h Self study : 14h

Description:
The chapter begins with the study of the properties of conductors at equilibrium and those of capacitors. The out-of-equilibrium charge transport is undertaken, and concepts as drift velocity, surface and volume current densities, are defined, as well as their relationship with the current intensity. After considering the charge conservation principle, we focus on the ohmic conductors, and resistance and conductivity are defined. Ohm's law is derived from the classical free electron model. At the end of the chapter, some simple circuits are solved and they are analyzed from the energetic point of view.

Magnetostatics.	Learning time: 28h 30m Theory classes: 8h Practical classes: 4h Guided activities: 0h 30m Self study : 16h

Description:
In this chapter we study the static magnetic field. We define the magnetic field from the force exerted on a charged particle in motion, the Lorentz force equation, and we describe the magnetic force on a current and on a magnet. We use both the Biot-Savart's law, which quantifies the magnetic fields produced by a differential element current, and the Ampère's law to evaluate the magnetic field created by static current distributions. We finish the chapter with the definition of the Ampère unit and the Gauss's law for the magnetic field.

Time dependent electric and magnetic fields. Maxwell's equations in vacuum.	Learning time: 29h 30m Theory classes: 8h Practical classes: 5h Guided activities: 0h 30m Self study : 16h

Description:
We start this chapter with the discussion of Maxwell's equations, no longer restricted to static fields, in integral form and in free space. We show that time dependent magnetic fields are capable of producing electric currents and non conservative electric fields (Faraday's law), and that a new type of current related with variations of the electric field appears and contributes to create a magnetic field (Ampère-Maxwell law). We also introduce Maxwell's equations in a point form. The LR circuit is energetically analyzed, and electromagnetic energy is defined. Poynting's theorem is derived. From Maxwell's laws we obtain the wave equation for electric and magnetic fields, which propagate at the velocity of light.

Qualification system

The evaluation will take into account the score of a final examination (EF),
a mid-term exam (EP), and
the activities of the student in the classroom, specifically the participation in practical classes (P).

The final mark will be calculated by
max{EF, 0.95*EF+0.05*P, 0.65*EF+0.30*EP+0.05*P}.

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Bibliography

Basic:

Tipler, P.A.; Mosca, G. Física per a la ciència i la tecnologia [on line]. 6a ed. Barcelona: Reverté, 2010 [Consultation: 22/11/2018]. Available on: <http://www.ingebook.com/ib/NPcd/IB_Browser_Pre?codigo_libro=6536>. ISBN 978-84-291-4431-4.

Halliday, D.; Resnick, R.; Walker, J. Fundamentals of physics [on line]. 10th ed. Hoboken, NJ: John Wiley & Sons, 2013 [Consultation: 11/01/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/detail.action?docID=10912884>. ISBN 9781118473818.

Complementary:

Ohanian, H.C.; Markert, J.T. Física para ingeniería y ciencias. 3a ed. México: Mc Graw Hill, 2009. ISBN 9789701067444 (VOL.1); 9789701067468 (VOL.2).

Purcell, E.M. Electricidad y magnetismo. 2a ed. Barcelona: Reverté, 1988. ISBN 842914319X.

Griffiths, D.J. Introduction to electrodynamics. 4th ed. Boston: Pearson, 2013. ISBN 9780321847812.

Ortega, M.R. Lecciones de Física: mecánica 4. Córdoba: Universidad de Córdoba. Departamento de Física Aplicada, 1992.