Last update: 10-07-2017

820005 - F2FE - Physics II: Fundamentals of Electromagnetism

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 748 - FIS - Department of Physics

Academic year: 2017

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: CRISTINA PERIAGO OLIVER
ÀNGELS RIERA MORA

Others: MARTA ALARCÓN, OLGA ALCARAZ, LLUÍS AMETLLER, MARIA DEL BARRIO, MARTÍ BELTRÁN, MURIEL BOTEY, GERMINAL CAMPS, ARJUNA CASTRILLÓN, DOMINGO GARCÍA, JONATHAN GEBBIA, JORDI JOSÉ, POL LLOVERAS, JOSÉ LÓPEZ, ROBERTO MACÓVEZ, LUIS CARLOS PARDO, CRISTINA PERIAGO, ÀNGELS RIERA, MARIA DOLORES RUIZ, GLÒRIA SALA, JOSEP LLUÍS TAMARIT

Prior skills

No prerequisites

Requirements

No requirements

Degree competences to which the subject contributes

Specific:

2. Understand the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism and apply them to engineering problems.

Transversal:

1. 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.

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Teaching methodology

Teaching methodology: exposition 30%, individual work 60%, group work 8% and guided activities 2%.

Learning objectives of the subject

The main objective is training students through the acquisition of a working method and providing knowledge of the principles and basic concepts of electromagnetism, so that can be applied to solving problems in the field of engineering.

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Item 1. Electric field and Potential

Learning time: 32h 30m

Theory classes: 10h
Laboratory classes: 2h
Guided activities: 1h
Self study : 19h 30m

Description:
The electric charge. Coulomb's law. Principle of superposition. Electric field created by a system of discrete charge and continuous distributions. Gauss's law: 1st Maxwell equation. Potential energy and electric potential. Calculation of the potential created by a system of discrete charge and continuous charge distributions. Electric energy of a system of point charges

Related activities:
Lab: Oscilloscope

Specific objectives:
Understand the concept of electric field and its vector nature. Calculate the field created by a charge distribution. Interpret the concept of potential, potential difference and electrostatic potential energy of a charge distribution.

Item 2. Conductors and dielectrics.

Learning time: 26h 15m

Theory classes: 10h
Guided activities: 0h 30m
Self study : 15h 45m

Description:
Conductor in electrostatic equilibrium. Electrostatic influence. Capacitors. Capacity. Associations of capacitors. Energy stored in a charged capacitor. Energy density of an electric field. Dielectrics: dielectric behavior inside an electric field. Capacitors with dielectrics.

Specific objectives:
Knowing the characteristics of a conductor in electrostatic equilibrium. Calculate the capacity of a capacitor of simple geometry and calculate the capacitor equivalent to an association of capacitors. Understand the concept of electrostatic field energy. Characterize the response of a dielectric in an electric field.

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Item 3. DC and AC

Learning time: 28h 45m

Theory classes: 5h
Practical classes: 6h
Guided activities: 0h 30m
Self study : 17h 15m

Description:
Electric current. Intensity and current density. Ohm's law. Electric resistance. Joule's law. emf: generators, motors and batteries. DC circuits. Kirchhoff's rules. RC circuit: charging and discharging a capacitor. Sinusoidal alternating quantities: graphical representation, phasors. AC: RLC series circuit. Impedance. Resonance. Active power. Power factor.

Related activities:
Lab:
- Electromotive force and internal resistance of a battery
- DC Circuits. Kirchhoff rules
- Capacitors. RC circuit.
- AC Circuits. RLC serie. Reactances.
- AC Circuits. RLC serie. Resonance.

Specific objectives:
Knowing how to establish relationships of macroscopic Ohm's law. Understand energy relationships in electrical circuits. Applying Kirchhoff's laws to solve circuits. Understand the process of charging and discharging a capacitor in an RC circuit.
Working with alternating magnitudes. Determine the reactance and impedance in an RLC circuit. Identify and characterize the phenomenon of resonance. Knowing energy features of the AC.

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Item 4. Magnetic field

Learning time: 31h 15m

Theory classes: 10h
Laboratory classes: 2h
Guided activities: 0h 30m
Self study : 18h 45m

Description:
Öersted experiment. Lorentz Force. A moving charge in a magnetic field. Particle accelerators. Velocity selector. Mass spectrograph. Magnetic force on an element of current. Torque over current loops. Hall effect. Sources of magnetic field: Biot and Savart's laws. Force between parallel currents. Definition of the ampere. Ampère's Law. The magnetic flux. Gauss's law for magnetism: 2nd Maxwell's equation.

Related activities:
Lab:
- Magnetic field in the center of a solenoid. Determination of the mutual inductance between two solenoids

Specific objectives:
Identify the electrical current as a source of magnetic field. Being able to calculate the force acting on a charge or a straight thread in the presence of a magnetic field. Calculate the magnetic dipole moment of a loop and identify the characteristics of motion of a loop under the action of a magnetic field. Calculate the magnetic field created by a distribution of currents using the Biot and Savart's law. Knowing Ampere's law and its applications.

Item 5. Electromagnetic inducction

Learning time: 26h 15m

Theory classes: 8h
Laboratory classes: 2h
Guided activities: 0h 30m
Self study : 15h 45m

Description:
Electromagnetic induction. Faraday-Lenz's law: 3rd Maxwell equation. Induced emf. Eddy currents. AC power generators. Self-inductance and mutual inductance. Power transformers. RL circuit. Energy stored in a coil. Magnetic energy density.

Related activities:
Lab:
- Coils. RL circuit in non-stationary dynamics.
- Magnetic field created by a set of coils. Determination of mutual inductance between two coils.
- Electromagnetic induction. Determination of mutual inductance between two coils.

Specific objectives:
Be able to relate the temporal variation of the flow of magnetic field with induction. To apply the Faraday-Lenz's law to calculate the electromotive force induced in different practical cases. Describe the inductive phenomena that appear in electric circuits. RL circuit.

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Item 6. Maxwell equations	Learning time: 5h Theory classes: 2h Self study : 3h

Description:
Displacement current: 4th Maxwell equation. Maxwell equations.

Specific objectives:
Explain the appearance of the displacement current in free space. Write Maxwell equations. Reconize the electromagnetic field in non-stationary situations.

Qualification system

MARK M1:
- Lab: 20%
- Test 1: 15%
- Test 2: 25%
- Test 3: 20%
- Problems: 20%

MARK M2:
- Lab: 20%
- Test 3: 40%
- Problems: 40%

FINAL GRADE = maximum (M1;M2)

Regulations for carrying out activities

In all exams, students can use a pocket calculator and bring a printed copy of the physics formula sheet provided in Atenea.

Bibliography

Basic:

Tipler, P. A.; Mosca, G. Física para la ciencia y la tecnología. 6a ed. Barcelona [etc.]: Reverté, 2010. ISBN 9788429144284.

Alcaraz i Sendra, Olga; López López, José; López Solanas, Vicente. Física : problemas y ejercicios resueltos. Madrid: Pearson Educación, cop. 2006. ISBN 8420544477.

Alarcón Jordán, Marta [et al.]. Física : problemes resolts. 2a ed. Barcelona: Edicions UPC, 1995-. ISBN 8483012197.