Course guide
820005 - F2FE - Physics II: Fundamentals of Electromagnetism

Unit in charge: Barcelona East School of Engineering
Teaching unit: 748 - FIS - Department of Physics.

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

Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: MARIA CRISTINA PERIAGO OLIVER - POL MARCEL LLOVERAS MUNTANE

Others:
Primer Quadrimestre:
Ametller Congost, Lluis
Escorihuela Sayalero, Carlos
Fernandez Martinez, Antonio
García Senz, Domingo
Gebbia, Jonathan Fernando
Lopez Lopez, Jose
Lloveras Muntane, Pol Marcel
Periago Oliver, Maria Cristina
Sola García, Marc

Segon quadrimestre:
Ametller Congost, Lluis
Benitez Colominas, Pol
Camps Anaya, Germinal
Escorihuela Sayalero, Carlos
Fernandez Martinez, Antonio
García Senz, Domingo
Gonzalez Reviriego, Nube
Jose Pont, Jordi
Lloveras Muntane, Pol Marcel
Noor, Wahi
Periago Oliver, Maria Cristina
Pradell Cara, Trinitat
Salvatori, Alejandro
Sau Valenzuela, Nuria
Sola García, Marc
Lopez Alvarez, Cibran
Ramirez Alba, Maria Dolores
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.

TEACHING METHODOLOGY

Teaching methodology: exposition 30%, individual work 60% and group work 10%.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>52,5</td>
<td>35.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>7,5</td>
<td>5.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**Item 1. Electric field and Potential**

Description:
The electric charge. Coulomb's law. 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.

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.

Full-or-part-time: 35h
Theory classes: 14h
Self study : 21h
**Item 2. Conductors and dielectrics.**

**Description:**

**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.

**Related activities:**
Lab:
- Parallel-plate capacitor with sheets of dielectric material.

**Full-or-part-time:** 32h 30m
Theory classes: 11h 30m
Laboratory classes: 1h 30m
Self study: 19h 30m

---

**Item 3. DC and AC**

**Description:**

**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.

**Related activities:**
Lab:
- Electromotive force and internal resistance of a battery
- DC Circuits. Kirchhoff rules
- Parallel-plate capacitor.
- AC Circuits. RLC serie. Reactances.
- AC Circuits. RLC serie. Resonance.

**Full-or-part-time:** 31h 15m
Theory classes: 8h
Practical classes: 4h 30m
Self study: 18h 45m
### Item 4. Magnetic field

**Description:**

**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.

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

**Full-or-part-time:** 28h 45m  
Theory classes: 11h  
Laboratory classes: 0h 30m  
Self study: 17h 15m

### Item 5. Electromagnetic induction

**Description:**

**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.

**Related activities:**
Lab:
- Magnetic field created by a set of coils. Determination of mutual inductance between two coils.  
- Electromagnetic induction. Determination of mutual inductance between two coils.

**Full-or-part-time:** 18h 45m  
Theory classes: 6h 30m  
Laboratory classes: 1h  
Self study: 11h 15m

### Item 6. Maxwell equations

**Description:**

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

**Full-or-part-time:** 3h 45m  
Theory classes: 1h 30m  
Self study: 2h 15m
GRADING SYSTEM

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

MARK M2:
- Lab: 15%
- Test 2: 25%
- Test 3: 30%
- Problems: 30%

MARK M3:
- Lab: 15%
- Test 3: 42.5%
- Problems: 42.5%

FINAL GRADE = maximum (M1;M2;M3)

EXAMINATION RULES.

It is mandatory to attend all lab sessions in order to be evaluated.
In all exams, students can use a pocket calculator and bring a printed copy of the physics formula sheet provided in Atenea.
The final exam of Physics 2 consists of Test 3 and Problems.
No re-evaluation exam has been considered in the grading policy of Physics 2.

BIBLIOGRAPHY

Basic: