Course guide
230855 - FM - Physics of Materials

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics.
Degree: MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Optional subject).
Academic year: 2022  ECTS Credits: 4.0  Languages: English

LECTURER
Coordinating lecturer: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura
Others: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS
There is not need of particular previous skills.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Basic:
CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

TEACHING METHODOLOGY
Lectures: In the lectures the contents of the subject are exposed orally by a teacher without the active participation of the students.
Problem solving: In the problem solving activity, the teacher presents an exercise / problem that the student must solve, either working individually or in a team.
Projects: Active teaching methodology that promotes learning from the realization of a project: idea, design, planning, development and evaluation of the project.

LEARNING OBJECTIVES OF THE SUBJECT
The mechanical, electrical and magnetic response, as well as their coupling, are the basis of advanced functional materials. These properties allow the application of these materials as sensors and actuators, which are the basic components in the development of emerging technologies. This course will explain the physical origin and how to evaluate the response of materials to external mechanical, electrical or magnetic stimuli. The coupling between the different properties and the multi-response mechanisms of the materials will be studied.
### STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>64.0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>36.0</td>
<td>36.00</td>
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</tbody>
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**Total learning time:** 100 h

### CONTENTS

**Mechanical properties**

**Description:**
1. Introduction to elasticity
2. Ferroelasticity. Landau theory of phase transitions
3. Microstructure
4. Structural phase transitions

**Full-or-part-time:** 25h  
Theory classes: 9h  
Self study: 16h

**Optical and electrical properties**

**Description:**
1. Polarization and polarization mechanisms
2. Ferroelectricity, Pyroelectricity, Piezoelectricity
3. Dielectric response to variable frequency electric fields
4. Optical response of materials

**Full-or-part-time:** 25h  
Theory classes: 9h  
Self study: 16h

**Magnetic properties**

**Description:**
1. Diamagnetism
2. Paramagnetism
3. Ferromagnetism
4. Other types of magnetism: ferrimagnetism, antiferromagnetism and non-collinear ferromagnetism

**Full-or-part-time:** 25h  
Theory classes: 9h  
Self study: 16h
### Magnetostuctural coupling

**Description:**
1. Ferroic and multiferroic transitions
2. Magnetoelasticity
3. Metamagnetism

**Full-or-part-time:** 25h  
Theory classes: 9h  
Self study : 16h

### GRADING SYSTEM

N1: Written tests. Exams, questionnaires, application activities and problem solving. N1 can be replaced by the mark of the re-evaluation exam.  
N2: Reports done by the student. Memories, dossiers and projects.

Final qualification = 0.6N1 + 0.4N2

### EXAMINATION RULES.

N1: Individual tests.  
N2: Made in teams.

### BIBLIOGRAPHY

**Basic:**

### RESOURCES

**Hyperlink:**  
- Magnetism Fundamentals, Materials and Applications.  