Course guide
230855 - FM - Physics of Materials

Last modified: 19/06/2024

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: 2024 **ECTS Credits:** 4.0 **Languages:** English

LECTURER

Coordinating lecturer: ELOY PINEDA SOLER

Others: Primer quadrimestre:
POL MARCEL LLOVERAS MUNTANE - 10
ELOY PINEDA SOLER - 10

PRIOR SKILLS

There is not need of particular previous skills.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Basic:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context

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

Type	Hours	Percentage
Self study	64,0	64.00
Hours large group	36,0	36.00

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

Magnetostructural 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:
- Salje, Ekhard K. H. Phase transitions in ferroelastic and co-elastic crystals : an introduction for mineralogists, material scientists, and physicists. Student ed. Cambridge [etc.]: Cambridge University Press, 1993. ISBN 0521429366.
- Wadhawan, Vinod K. Introduction to ferroic materials. Amsterdam: Gordon & Breach, 2000. ISBN 9056992864.

RESOURCES

Hyperlink:
- Magnetism Fundamentals, Materials and Applications.. https://link-springer-com.recursos.biblioteca.upc.edu/referencework/10.1007/978-0-387-23062-7