

## Course guide

# 240EM113 - 240EM113 - Electrical, Magnetic, Optical and Thermal Properties of Materials

Last modified: 26/06/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 702 - CEM - Department of Materials Science and Engineering.  
**Degree:** ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).  
**Academic year:** 2025    **ECTS Credits:** 3.0    **Languages:** Spanish

## LECTURER

**Coordinating lecturer:** Roa Rovira, Joan Josep

**Others:** Roa Rovira, Joan Josep

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

### Specific:

CEMCEM-01. (ENG) Aplicar coneixements de matemàtiques, física, química, biologia i altres ciències naturals, obtinguts mitjançant estudi, experiència i, pràctica, amb raonament crític per a establir solucions viables a problemes tècnics.

CEMCEM-04. (ENG) Realitzar estudis de caracterització, avaluació i certificació de materials segons les seves aplicacions

### Transversal:

06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

## TEACHING METHODOLOGY

Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

## LEARNING OBJECTIVES OF THE SUBJECT

The aim of the course is that students acquire basic knowledge about the physical properties of materials.

At the end of the course the student should be able to:

- ? Understand the basics of solid state physics
- ? Identify the main optical effects of materials and understand the interaction between light and materials
- ? Clasify materials according to their electrical behavior. Relate the macroscopic electrical behavior with the behavior of electrons in materials
- ? Differentiate between the different magnetic responses of materials. Identify the main magnetic parameters of ferromagnetic and ferrimagnetic materials

## STUDY LOAD

Type	Hours	Percentage
Hours small group	9,0	12.00
Self study	48,0	64.00
Hours large group	18,0	24.00

**Total learning time:** 75 h



## CONTENTS

### Introduction to Solid State Physics

**Description:**

The atom and the periodic table. Basics of quantum physics. Schödinger equation. Atom&Molecular orbitals. Energy bands in solids. Kronig-Penney model. Density of states. Fermi-Dirac function & calculation of charge/magnetic momentum carriers. Clasificaction of materials according to their band structure

**Full-or-part-time:** 22h

Theory classes: 8h

Self study : 14h

### Electricity

**Description:**

Electric fields and parameters. Theory of conductivity. Metals. Intrinsic semiconductors. Extrinsic semiconductors. dielectrics

**Full-or-part-time:** 19h

Theory classes: 8h

Self study : 11h

### Magnetism

**Description:**

Magnitudes and magnetic fields. Diamagnetic, paramagnetic, ferromagnetic and ferrimagnetic materials. Behavior with temperature: Curie temperature. Magnetic Domines. Magnets

**Full-or-part-time:** 15h

Theory classes: 6h

Self study : 9h

### Optics

**Description:**

Nature of light. Interaction with materials. Reflection, refraction and absorption. Polarization. Scattering. Introduction to color. Interference and diffraction.content english

**Full-or-part-time:** 13h

Theory classes: 9h

Laboratory classes: 4h

### Thermal properties

**Description:**

Thermal magnitudes and their relationship to materials. Phonons. Heat capacity. Conductivity. Thermal Shock

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h



## GRADING SYSTEM

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Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

## BIBLIOGRAPHY

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### Basic:

- Solymar, L. ; Walsh, D. Electrical properties of materials [on line]. 9th ed. New York: Oxford University Press, 2014 [Consultation: 03/02/2022]. Available on : <https://oxford-universitypressscholarship-com.recursos/view/10.1093/oso/9780198829942.001.0001/oso-9780198829942>. ISBN 9780198702771.
- Hummel, Rolf E. Electronic properties of materials. 4th ed. New York, NY: Springer New York, cop. 2011. ISBN 9781441981646.
- White, Mary Anne. Physical properties of materials. 3rd ed. Florida: CR Press, 2019. ISBN 9781138605107.

### Complementary:

- Rosenberg, H. M. The Solid state: an introduction to the physics of solids for students of physics, materials science, and engineering. 3rd ed. Oxford: Oxford University Press, 1989. ISBN 0198518706.