

## Course guide

# 295708 - PEMM - Electrical and Magnetic Properties of Materials

Last modified: 02/10/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 702 - CEM - Department of Materials Science and Engineering.  
**Degree:** BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).  
**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** Spanish

### LECTURER

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**Coordinating lecturer:** EMILIO JIMENEZ PIQUÉ

**Others:** Primer quadrimestre:  
HOSSEIN BESHARATLOO - Grup: M11, Grup: M12  
EMILIO JIMENEZ PIQUÉ - Grup: M11, Grup: M12  
MARC SERRA FANALS - Grup: M13

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEM1. Knowledge on several types of materials' structure, as well as analysis characterisation and techniques of materials.  
CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.  
CEMT-20. Knowledge of the mechanical, electronic, chemical and biological behaviour of materials, and the ability to apply it in designing, calculating and modelling aspects of elements, components and equipment.

**Transversal:**

04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

### TEACHING METHODOLOGY

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During the course theory and problems, along with experimental demonstrations are taught. Several tests are performed, as well as a presentation and laboratory

### LEARNING OBJECTIVES OF THE SUBJECT

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The aim of the course is to help 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 as well as the behaviour of electrons in solids
- ? Classify materials according to their electrical behavior. Relate the macroscopic electrical behavior with the behavior of electrons in materials
- ? Distinguish the different magnetic responses of materials. Identify key parameters of ferro magnetic and ferrimagnetic materials



## STUDY LOAD

Type	Hours	Percentage
Hours large group	50,0	33.33
Self study	90,0	60.00
Hours small group	10,0	6.67

**Total learning time:** 150 h

## CONTENTS

### UNIT I: Introduction to Solid State Physics

**Description:**

Quantum behavior of particles. Principal quantum equations. Schrödinger equation. Structure of atom and molecules. Kröning-Penney equation for crystals. Density of state. Fermi distribution function. Density of Carriers

**Full-or-part-time:** 50h

Theory classes: 12h

Practical classes: 8h

Self study : 30h

### UNIT II: Electrical behavior of materials

**Description:**

Classification of the electrical behavior of the materials. Conductivity in metals. Intrinsic and extrinsic semiconductors. semiconductor union. Electrostatics. Dielectrics.

**Full-or-part-time:** 50h

Theory classes: 12h

Practical classes: 8h

Self study : 30h

### UNIT III: Magnetic behavior of materials

**Description:**

Types of magnetism. Curie temperature. Ferro and ferrimagnetic materials. Domains. superconductivity

**Full-or-part-time:** 50h

Theory classes: 12h

Practical classes: 8h

Self study : 30h

## GRADING SYSTEM

Final Exam 49% + 30% Partial Tests + 6% presentation+ 15% lab

Reevaluation exam is programmed.

## BIBLIOGRAPHY

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### Basic:

- Hummel, Rolf E. Electronic properties of materials. 4th. New York: Springer, 2011. ISBN 9781441981639.
- Solymar, L. Electrical properties of materials. 9th ed. Oxford: Oxford University Press, 2014. ISBN 9780198702771.
- Rosenberg, H. M ; Gómez Antón, Ana. El Estado sólido : una introducción a la física de los cristales. Madrid: Alianza Editorial, cop. 1991. ISBN 9788420681405.
- Turton, Richard. The Physics of solids. New York: Oxford University Press, 2000. ISBN 0198503520.
- Pollock, D. D. Physical properties of materials for engineers. 2nd ed. 1993. ISBN 0849342376.

### Complementary:

- White, Mary Anne. Properties of materials. New York: Oxford University Press, 1999. ISBN 0195113314.
- Kittel, Charles. Introduction to solid state physics. 8th ed. New York [etc.]: John Wiley & Sons, cop. 2005. ISBN 047141526X.
- Jiles, David. Introduction to magnetism and magnetic materials. Third edition. Boca Raton: CRC Press, Taylor & Francis Group, cop. 1998. ISBN 9781482238877.