Course guide
295708 - PEMM - Electrical and Magnetic Properties of Materials

Last modified: 04/06/2026

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: 2026 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: EMILIO JIMENEZ PIQUÉ

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

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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 fundaments. 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

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

LEARNING OBJECTIVES OF THE SUBJECT

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

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

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

Reevaluation exam is programmed.

BIBLIOGRAPHY

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.