

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

	Last modified: 08/08/2024		
Unit in charge: Teaching unit:	Barcelona East School of Engineering 702 - CEM - Department of Materials Science and Engineering.		
Degree:	BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).		
Academic year: 2024	ECTS Credits: 6.0 Languages: Spanish		
LECTURER			
Coordinating lecturer:	EMILIO JIMENEZ PIQUÉ		
Others:	Primer quadrimestre: PABLO GUARDIA GIRÓS - Grup: M11 EMILIO JIMENEZ PIQUÉ - Grup: M11, Grup: M12		

## **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.

MARC SERRA FANALS - Grup: M12

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

Туре	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 50% + 30% Partial Tests + 5% presentation + 15% lab NO reevaluation



# **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.