



## Course guide

# 820011 - CTM - Materials Science and Technology

**Last modified:** 14/06/2023

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 702 - CEM - Department of Materials Science and Engineering.

**Degree:** BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Catalan, Spanish, English

### LECTURER

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**Coordinating lecturer:** JOSE ANTONIO BENITO PARAMO - JORDI LLUMA FUENTES

**Others:**

TARDOR:

Benito Paramo, Jose Antonio  
Español Pons, Montserrat  
Gutiérrez Castillo, Joan David  
López Insa, Isaac  
Lluma Fuentes, Jordi  
Mas Moruno, Carlos  
Punset Fuste, Miguel  
Romero Pedret, Xavier Andres  
Solà Saracibar, Joan  
Sorita Lledo, Blas

PRIMAVERA:

Abt, Tobias Martin  
Benito Paramo, Jose Antonio  
Cuadrado Lafoz, Núria  
Chausse Calbet, Victor  
Del Mazo Barbarà, Laura  
Díez Escudero, Anna  
Español Pons, Montserrat  
Fooladimahani, Saghar  
Garcia Fernandez, Victor Gerardo  
Garcia Marro, Fernando  
Guardia Girós, Pablo  
Gutiérrez Castillo, Joan David  
López Insa, Isaac  
Llanes Pitarch, Luis Miguel  
Martínez Alanis, Paulina Raquel  
Mas Moruno, Carlos  
Molmeneu Trias, Meritxell  
Razavi, Seyed Ali  
Romero Pedret, Xavier Andres



Solà Saracibar, Joan  
Sorita Lledo, Blas  
Sousa Machado, Pedro Vinicius

## PRIOR SKILLS

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Basic chemistry, particularly atomic theory, electronic structure and electrochemistry.  
Logarithmic and exponential functions.  
Trigonometric functions.  
Derivatives, integrals and basic calculations.  
Office automation software (spreadsheets and word processors).

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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### Specific:

2. Understand the fundamentals of materials science, technology and chemistry. Understand the relationship between the microstructure, synthesis or processing and the properties of materials.

### Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

## TEACHING METHODOLOGY

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The course is divided up as follows:

- 20% face-to-face expository classes (theory)
- 10% face-to-face directed classes (problem solving)
- 10% practical work (laboratory)
- 57% self-directed learning (study)
- 3% exams

## LEARNING OBJECTIVES OF THE SUBJECT

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On completion of the course, students should be able to:

- Distinguish between the different structures of materials and relate them with the materials' properties and applications.
- Understand and apply material-testing standards.

## STUDY LOAD

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Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	45,0	30.00

**Total learning time:** 150 h



## CONTENTS

### Atomic Structure, Organisation and Movement

**Description:**

Chemical bonds and types of materials.  
Crystalline structures and imperfections.  
Steady-state and non-steady-state diffusion.  
Plastic deformation mechanisms

**Specific objectives:**

Relate materials' electronic structures, chemical bonds and general properties to one another.  
Relate crystalline structures and their defects to the general behaviour of families of materials.  
Identify diffusion mechanisms in solid materials, their time dependence and applicable equations.  
Study plastic deformation mechanisms in metal materials, the potential interaction between crystalline network defects and the mechanical behaviour of the material. Infer the limit condition for plastic deformation.  
Practical 1. Learn and practise the method for metallographic preparation of metal materials and identify the goodness of a sample by comparing it to established standards.  
Practical 3. Establish and practise the grain size measurement method for metal materials and establish the order of magnitude.

**Related activities:**

Practical 1. Metallographic preparation.  
Practical 3. Grain size measurement.

**Full-or-part-time:** 34h

Theory classes: 10h  
Laboratory classes: 5h  
Self study : 19h

### Physical Properties

**Description:**

Electrical conduction. Semiconductors.  
Thermal properties.  
Magnetic properties.

**Specific objectives:**

For students to acquire the ability to define the properties of materials used in electrical, thermal and magnetic applications, the tests used to quantify these properties and the typical values in specific families of materials.

**Related activities:**

Practical 6. Measurement of electrical and thermal properties of metal materials.

**Full-or-part-time:** 42h

Theory classes: 13h  
Laboratory classes: 2h 30m  
Self study : 26h 30m

### Mechanical Properties

**Description:**

Elastic and plastic deformation.  
Mechanical tests.  
Failure and fracture mechanics.

**Specific objectives:**

To acquire the ability to define the relevant properties of materials used in structural applications, the tests used to quantify these properties and the values typical of families of materials.

**Related activities:**

Practical 2. Traction and resilience tests.  
Practical 4. Material hardness tests.

**Full-or-part-time:** 38h

Theory classes: 12h  
Laboratory classes: 5h  
Self study : 21h

### Phase and Microstructure Control Diagrams.

**Description:**

Phase diagrams.  
Fe-C diagram.  
Cold work and recrystallisation.

**Specific objectives:**

For students to understand how phase diagrams work and the influence of heat treatment on the properties of materials.

**Related activities:**

Practical 5. Evolution of hardness according to the heat treatment and degree of plastic deformation applied to metal materials.

**Full-or-part-time:** 31h

Theory classes: 10h  
Laboratory classes: 2h 30m  
Self study : 18h 30m

### Corrosion and Degradation

**Description:**

Corrosion in metal materials.  
Degradation of polymers and ceramics.

**Specific objectives:**

Define the conditions in which materials corrode and degrade.

**Full-or-part-time:** 5h

Self study : 5h



## GRADING SYSTEM

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Partial exam: 32%  
Final exam: 48%  
Laboratory: 15%  
Self-directed learning: 5%

The subject has a reevaluation test. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (<https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf>)

## EXAMINATION RULES.

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The use of any electronic equipment with wireless communication capabilities is strictly forbidden in the evaluations.

## BIBLIOGRAPHY

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### Basic:

- Callister, William D. Introducción a la ciencia e ingeniería de los materiales [on line]. 2ª ed. México, D.F.: Limusa Wiley, 2009 [ Consultation: 24/11/2021]. Available on: <https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=2616389>. ISBN 9786075000251.

### Complementary:

- Smith, William F. Fundamentos de la ciencia e ingeniería de materiales [on line]. 5ª ed. México [etc.]: McGraw-Hill, 2014 [ Consultation: 27/04/2020]. Available on: [http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=5732](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5732). ISBN 9781456240004.  
- Shackelford, James F. Introducción a la ciencia de materiales para ingenieros [on line]. 7ª ed. Madrid [etc.]: Pearson Educación, 2010 [ Consultation: 27/04/2020]. Available on: [http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=1258](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1258). ISBN 9788483226599.  
- Cruells Cadevall, Montserrat [et al.]. Ciència dels materials. 2a ed. Barcelona: Publicacions i Edicions de la Universitat de Barcelona, 2011. ISBN 9788447535125.