



Course guides

820011 - CTM - Materials Science and Technology

Last modified: 11/07/2020

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

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

Academic year: 2020 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: José Antonio Benito Páramo

Others:

Primer quadrimestre:

JOSE ANTONIO BENITO PARAMO - M21, M22, M23, M24, M25
JUDIT BUXADERA PALOMERO - M25
FERHUN CEM CANER - M13, M14
SALVADOR DOMINGO DURAN - T11, T12, T13, T14, T21, T22, T23, T24
JORDI JORBA PEIRÓ - M11, M12, M13, M14
ISAAC LÓPEZ INSA - T11, T12
MERITXELL MOLMENEU TRIAS - M23, M24
MIQUEL PUNSET FUSTE - T21, T22
ERICA ROITERO - M11, M12
XAVIER ANDRES ROMERO PEDRET - T13, T14
JOAN SOLÀ SARACIBAR - M21, M22, T23, T24

Segon quadrimestre:

TOBIAS MARTIN ABT - M42, M52
JOSE ANTONIO BENITO PARAMO - M11, M12, M13
JUDIT BUXADERA PALOMERO - M51
FERHUN CEM CANER - M55
NÚRIA CINCA I LUIS - T14
NÚRIA CUADRADO LAFOZ - M21, M22, M23, M24, M25
SALVADOR DOMINGO DURAN - T11, T12, T13, T14, T21, T22, T23, T24, T25
MONTSERRAT ESPAÑOL PONS - M41, M42, M43, M44, M45
VICTOR GERARDO GARCIA FERNANDEZ - T11, T33, T34
JOSÉ MANUEL GARCÍA TORRES - M31, M32, M33, M34, M35
PABLO GUARDIA GIRÓS - M51, M52, M53, M54, M55
JUAN DAVID GUTIÉRREZ CASTILLO - T12, T25
AINA HERAS PARETS - M44
NOEL LEÓN ALBITER - M23, M43
JORDI LLUMA FUENTES - M41
ISAAC LÓPEZ INSA - T21, T22
ANDREA MALANDRINO - T31, T32, T33, T34
MERITXELL MOLMENEU TRIAS - M24
JAUME PUJANTE AGUDO - M53, M54
MIQUEL PUNSET FUSTE - M31, M32, M35
ERICA ROITERO - M11, M12

XAVIER ANDRES ROMERO PEDRET - M25, M33, M34, M45
JOAN SOLÀ SARACIBAR - M21, M22, T13, T23, T24, T31, T32

PRIOR SKILLS

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

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

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

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

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	15,0	10.00
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: 30h

Theory classes: 9h
Laboratory classes: 5h
Self study : 16h

Phase and Microstructure Control Diagrams.

Description:

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

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: 27h

Theory classes: 9h
Laboratory classes: 2h 30m
Self study : 15h 30m



Corrosion and Degradation

Description:

Corrosion in metal materials.
Degradation of polymers and ceramics.

Specific objectives:

For students to acquire the ability to define the conditions in which materials corrode and degrade, the properties that prevent corrosion and degradation and the most relevant families of materials.

Full-or-part-time: 11h

Theory classes: 3h
Self study : 8h

Physical Properties

Description:

Electrical conduction. Semiconductors. Dielectrics. Other electrical properties.
Thermal properties.
Magnetic properties.
Optical properties.

Specific objectives:

For students to acquire the ability to define the properties of materials used in electrical, thermal, magnetic and optical 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: 38h

Theory classes: 13h
Laboratory classes: 2h 30m
Self study : 22h 30m

Mechanical Properties

Description:

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

Specific objectives:

For students 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: 33h

Theory classes: 10h
Laboratory classes: 5h
Self study : 18h



GRADING SYSTEM

Partial exam: 30%
Final exam: 50%
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.

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

BIBLIOGRAPHY

Basic:

- Callister, William D. Introducción a la ciencia e ingeniería de los materiales. 2ª ed. México, D.F.: Limusa Wiley, 2009. 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. 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. ISBN 9788483226599.

- Cruells Cadevall, Montserrat [et al.]. Ciència dels materials. 2a ed. Barcelona: Publicacions i Edicions de la Universitat de Barcelona, 2011. ISBN 9788447535125.