Course guides
820011 - CTM - Materials Science and Technology

Last modified: 04/07/2021

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: 2021 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: José Antonio Benito Páramo - Jordi Llumà Fuentes

Others: Primer quadrimestre:
JOSE ANTONIO BENITO PARAMO
MONTSERRAT ESPAÑOL PONS
MIGUEL MORALES COMAS
JUSTIN ZOPPE

Segon quadrimestre:
TOBIAS ABT
JOSE ANTONIO BENITO PARAMO
NURIA CUADRADO LAFOZ
JOSE MANUEL GARCÍA TORRES
PABLO GUARDIA GIROS
ANDREA MALANDRINO
CARLES MAS MORUNO
JAIRO MUÑOZ

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
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 ans 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

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.

The use of any electronic equipment with wireless communication capabilities is stricty 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.