Last update: 10-07-2017

820011 - CTM - Materials Science and Technology

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy

Academic year: 2017

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

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: José Antonio Benito Páramo

Others: José Antonio Benito Páramo
Victor García Fernández
Jordi Jorba Peiró
Jordi Llumà Fuentes
Joan Solà Saracibar
Salvador Domingo
Casas Quesada, Casimir
Romero Pedret, Xavier Andres
Torres Garrido, Diego Alejandro
Velasco Ayguasanosa, Arnau
Valle Chiro, Jorge

Opening hours

Timetable: See ftp://ftp-urgell.upc.es/materials/inici.htm or Atenea, as indicated by the docent.

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:

820011 - CTM - Materials Science and Technology

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

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 10-07-2017

820011 - CTM - Materials Science and Technology

Content

Atomic Structure, Organisation and Movement

Learning time: 30h

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

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

Related activities:
Practical 1. Metallographic preparation.
Practical 3. Grain size measurement.

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.

Mechanical Properties

Learning time: 33h

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

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

Related activities:
Practical 2. Traction and resilience tests.
Practical 4. Material hardness tests.

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.

820011 - CTM - Materials Science and Technology

Phase and Microstructure Control Diagrams.	Learning time: 27h Theory classes: 9h Laboratory classes: 2h 30m Self study : 15h 30m

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

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

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

Corrosion and Degradation	Learning time: 11h Theory classes: 3h Self study : 8h

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.

Last update: 10-07-2017

820011 - CTM - Materials Science and Technology

Physical Properties

Learning time: 38h

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

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

Related activities:
Practical 6. Measurement of electrical and thermal properties of metal materials.

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.

Material Selection

Learning time: 11h

Theory classes: 6h
Self study : 5h

Description:
Ashby diagrams.

Specific objectives:
For students to acquire the ability to identify the properties that define a given application and select the material (or family of materials) that can best provide these properties.

Qualification system

Partial exam: 30%
Final exam: 50%
Laboratory: 15%
Self-directed learning: 5%

The subject has a reevaluation test according to specific regulations of the school

Regulations for carrying out activities

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

820011 - CTM - Materials Science and Technology

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. 4ª ed. México [etc.]: McGraw-Hill, 2006. ISBN 9701056388.

Shackelford, James F. Introducción a la ciencia de materiales para ingenieros. 7ª ed. Madrid [etc.]: Pearson Educación, 2010. ISBN 9788483226599.

Cruells Cadevall, Montserrat [et al.]. Ciència dels materials. Barcelona: Universitat de Barcelona, 2007. ISBN 978-84-4753-178-3.