



Universitat de Lleida

DEGREE CURRICULUM  
**MATERIALS SCIENCE**

Coordination: Jordi Casanovas

Academic year 2014-15

## Subject's general information

<b>Subject name</b>	Materials Science
<b>Code</b>	102113
<b>Semester</b>	2n Q Continuous assessment
<b>Typology</b>	Obligatòria
<b>ECTS credits</b>	6
<b>Groups</b>	2 Big Groups , 4 Middle Groups
<b>Theoretical credits</b>	0
<b>Practical credits</b>	0
<b>Coordination</b>	Jordi Casanovas
<b>Office and hour of attention</b>	Jordi Casanovas Thursday 16h-18h / Office 2.14 (EPS) Josep Monné Thursday 17-18h i Dv. 18-19h / Office 2.14 (EPS)
<b>Department</b>	Chemistry
<b>Modality</b>	Presencial
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.
<b>Language</b>	Català
<b>Degree</b>	Degree in Automation and Industrial Electronic Engineering Degree in Mechanical Engineering
<b>Office and hour of attention</b>	Jordi Casanovas Thursday 16h-18h / Office 2.14 (EPS) Josep Monné Thursday 17-18h i Dv. 18-19h / Office 2.14 (EPS)
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Jordi Casanovas Salas (morning groups)  
Josep Monne Esquerda (afternoon groups)

## Subject's extra information

Continuous work of students throughout the semester, reading basic references and solving exercises. Visit the Virtual Campus frequently, since there will be uploading useful material: backup of the theoretical presentations, collections of exercises, instructions for the practices ... Take advantage of office hours / tutoring with teachers.

## Learning objectives

see competences

## Competences

### Degree-specific competences

- Knowledge and use of the principles of the resistance of materials.

#### Goals

- Knowing the mechanical behavior -in particular the mechanical strength- of metals, ceramics and polymers.
  - Knowing how to evaluate the main mechanical properties
- Knowledge of the principles of science, technology and the chemistry of materials. Understanding of the relationship between microstructure, synthesis or processing and properties of materials.

#### Goals

- Knowing the main characteristics of metals (and metal alloys), ceramics, polymers, semiconductors and composite materials
- Improve the knowledge of their crystal and non-crystalline structures, as well as of their structural defects and atomic diffusion phenomenon.
- Understand the physical and chemical properties (mechanical, electrical, magnetic, thermal, optical, corrosion) of different types of materials available to an engineer. Learn to evaluate some parameters to characterize the properties.
- Understanding the relationship between internal structure and material properties

### Degree-transversal competences

- Ability to work under pressure and/or in situations where there is a lack of information.

#### Goals

- Learn to find and choose, in a limited time, the necessary information to solve a problem of Materials Science.
- Ability to resolve problems and elaborate and defend arguments inside their field of study

#### Goals

- Learning to think, solve and explain correctly a problem of Materials Science.

## Subject contents

## **1. Introduction**

- 1.1. Definition of Materials Science and Materials Engineering
- 1.2. Structure and Properties.
- 1.3. Classification of materials.
- 1.4. Current needs of society.

## **2. Crystal structure and non-crystalline structure**

- 2.1. Introduction
- 2.2. Common crystal structures
  - 2.2.1. Metals
  - 2.2.2. Ceramics
  - 2.2.3. Semiconductors
- 2.3. Structural characteristics of polymers
- 2.4. Composites

## **3. Imperfections and diffusion phenomena**

- 3.1. Deviations from the ideal crystal structure
  - 3.1.1. Punctual defects
  - 3.1.2. Linear defects: dislocations
  - 3.1.3. Surface defects
  - 3.1.4. Volume defects
- 3.2. Diffusion phenomena
  - 3.2.1. General considerations
  - 3.2.2. Mechanisms for diffusion
  - 3.2.3. Factors affecting the diffusion
  - 3.2.4. Applications

## **4. Mechanical properties**

- 4.1. Laboratory tests: relation stress - strain
- 4.2. Elastic deformation and plastic deformation
  - 4.2.1. Elastic deformation. Modulus of elasticity
  - 4.2.2. Plastic deformation
  - 4.2.3. Hardness

4.3. Mechanical and thermomechanical properties of polymers

4.4. Reinforcement techniques

4.5. Fracture and Fatigue

## **5. Electrical properties**

5.1. Introduction

5.2. Band Theory

5.3. Metallic conductivity

5.4. Semiconductors

5.4.1. Intrinsic semiconductors

5.4.2. Extrinsic

semiconductors

5.5. Conductivity in ceramics, polymers and composites

## **6. Magnetic properties**

6.1. General concepts

6.2. Non-cooperative magnetic behavior: diamagnetism and paramagnetism

6.3. Cooperative magnetic behavior: ferro-, antiferro-and ferrimagnetism

6.4. Influence of temperature

6.5. Magnetic hysteresis cycle

6.6. Magnetically hard and soft materials

6.7. Superconductors

## **7. Optical and thermal properties**

7.1. Thermal properties: heat capacity, thermal expansion, thermal conductivity

7.2. Thermal properties of polymers

7.3. Optical properties

7.4. Applications of optical phenomena: luminescence, photodegradation, laser and fiber optics

## **8. Corrosion of Materials**

8.1. Introduction

8.2. Atmospheric attack: oxidation

8.3. Electrochemical attack

8.3.1. Ion concentration batteries

8.3.2. Galvanic batteries

8.3.3. Gaseous reduction

8.4. Methods to prevent corrosion

## Evaluation

Evaluation Activity 1 (AA1). Written exam, Topics 1-4, Final score percentage: 25%

Evaluation Activity 2 (AA2). Written exam, Topics 1-8, Final score percentage: 50%

Laboratory Activities. Final score percentage: 10%

Other Activities. Multiple choice Tests (initially scheduled , at the end of each topic) . Final score percentage: 15%

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Recovery evaluation activity. It allows to recover 75% of the Final score (equivalent to AA1+AA2)

## Bibliography

### Recommended bibliography

- J.C.Anderson, K.D. Leaver, R.D. Rawlings y J.M. Alexander, "*Ciencia de los Materiales*", 2<sup>a</sup> ed., Ed.Limusa, México, 1998
- D.R.Askeland, "*Ciencia e Ingeniería de los Materiales*", InternationalThomson Editores, México, 1998
- W.D.Callister Jr., "*Introducción a la Ciencia e Ingeniería de los Materiales*", 3<sup>a</sup> ed., Ed.Reverté S.A.,Barcelona, 1995
- J.Casanovas y C. Alemán, "*Introducción a la Ciencia de los Materiales*", CálamoProducciones Editoriales,Colección Manuales Básicos, Barcelona, 2002
- J.F.Shackelford, "*Introducción a la Ciencia de Materiales para Ingenieros*", 4<sup>a</sup> ed., PrenticeHall Iberia, Madrid, 1998
- W.F. Smith, "*Fundamentos de la Ciencia e Ingeniería deMateriales*", 3<sup>a</sup> ed., McGraw-Hill, Madrid, 1998

**Other didactic material** s'aniràpenjant al Campus Virtual: <http://cv.udl.cat>