

## 27218 - Materials Science

### Información del Plan Docente

<b>Academic Year</b>	2016/17
<b>Academic center</b>	100 - Facultad de Ciencias
<b>Degree</b>	452 - Degree in Chemistry
<b>ECTS</b>	7.0
<b>Course</b>	4
<b>Period</b>	Annual
<b>Subject Type</b>	Compulsory
<b>Module</b>	---

### **1.Basic info**

#### **1.1.Recommendations to take this course**

#### **1.2.Activities and key dates for the course**

### **2.Initiation**

#### **2.1.Learning outcomes that define the subject**

#### **2.2.Introduction**

### **3.Context and competences**

#### **3.1.Goals**

#### **3.2.Context and meaning of the subject in the degree**

#### **3.3.Competences**

#### **3.4.Importance of learning outcomes**

### **4.Evaluation**

### **5.Activities and resources**

#### **5.1.General methodological presentation**

The learning process that has been designed for this course is based on the following activities:

1. Master classes including case studies and problem-solving activities and the 'Materials Science Day' to complement the view of the subject presented at the lectures (5 ECTS).
2. Supervised projects presented at seminar classes (2 ECTS)

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3. Personalized tutoring to help with individual questions and project preparation.

### 5.2. Learning activities

The program offered to the students to help them achieve the learning results includes the following activities:

Activities to provide students the basic knowledge of materials science including theoretical issues and, problem and practical cases analysis to apply the acquired theoretical knowledge. This activity is carried out in the classroom with the whole group.

Supervised projects and preparation of seminars that include

- Development of a project proposal consisting on a bibliographic research about a practical case or a specific issue on Materials Science by a small working group
- Tutorials to monitor project progress.
- Preparation of a written report.
- Oral presentation of the project through critical analysis of the case studies in participatory seminars.

Materials Science Day that includes guest talks from high level specialists in their fields to provide a complementary sight to the lectures (the content of this activity will also be assessed). The active student participation will be encouraged. Scheduling and implementation of the activity will depend on the availability of contacted professionals.

### 5.3. Program

The contents of programmed activities of the course that will be assessed are the following:

1. **Definition and classification of materials**
2. **Metals: Mechanical properties.** Mechanical properties. Crystal structures. Plastic deformation. Hardening of metals. Recovery and recrystallization of plastically deformed metals. Fracture and fatigue. Fluency and stress at break. Metals and alloys processing
3. **Metals: Alloys** . Production of iron and steel. Diagrams of condensed phases. Phase diagram iron-iron carbide. TTT diagrams. Thermal annealing of steel. Types of iron alloys. Aluminum and copper alloys. Other metal alloys. Refractory metals. Selection and use restrictions: corrosion.
4. **Ceramics and glasses.** Structure and properties. Raw materials. Ceramics processing. Thermal insulators and special coatings. Advanced ceramics. Glasses. Zeolites. Cements. Selection and use restrictions.
5. **Polymers: Structure and properties.** Polymerization and molecular mass. Chemical structure and stereochemistry. Amorphous and semicrystalline polymers. Mechanical and thermomechanical properties. Introduction to rheology. Other properties and testing of polymers.
6. **Polymers: Processing and applications** . Processing of polymers: Extrusion and molding. Additives in polymers. Natural and semisynthetic polymers. Thermoplastics. Thermosettings. Polymer foams, fibers and other polymeric derivatives. Selection and limits in the use of polymers. Sustainable production of polymers.
7. **Composites** . Classification. Matrices and reinforcements. Composites reinforced with particles. Fiber reinforcement. Influence of fiber-matrix interaction in mechanical properties. Other composites. Nanomaterials and its use for composites.
8. **Electrical and Electronic Materials.** Electrical conductivity and resistivity. Dielectric and ferroelectric materials. Semiconductor materials and applications. Materials for the electronic industry. Materials for energy storage.
9. **Magnetic Materials.** Diamagnetism and paramagnetism. Ferromagnetism, antiferromagnetism and ferrimagnetism. Soft and hard magnetic metals and alloys. Permanent magnetic materials. Magnetic storage. Influence of temperature. Superconductors
10. **Optical Materials.** Introduction. Optical fiber and applications. Photo and electroluminescent materials. Lasers. Photoconductors. Liquid crystals and displays.
11. **Biomaterials:** Types of materials and applications. Metallic biomaterials. Bioceramics. Polymeric biomaterials and applications. Applications in therapy and diagnosis. Regenerative medicine. Nanobiomedicine.

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12. **New materials**
13. **Environmental impact on Materials Science**
14. **Characterization techniques for materials**

Topics in new materials, environmental impact or characterization techniques of materials will be alternatively covered in seminars (by students).

### 5.4.Planning and scheduling

Lectures calendar can be consulted in <http://ciencias.unizar.es/web/horarios.do>

Supervised project presentations will be held during the second semester and dates will be duly announced.

Materials Science Day will be held in the second semester and will be timely announced

### 5.5.Bibliography and recommended resources

**BB** Askeland, Donald R.. Ciencia e ingeniería de los materiales / Donald R. Askeland . - Ed. española Madrid : Paraninfo, Thomson Learning, D.L. 2001

**BB** Callister, William D., jr.. Ciencia e ingeniería de los materiales / William D. Callister, jr., David G. Rethwisch ; versión española por, Pere Molera Solà , Núria Salán Ballesteros . - 2ª ed. Barcelona [etc] : Reverté, 2016

**BB** Callister, William D., jr.. Introducción a la ciencia e ingeniería de los materiales / William D. Callister, jr ; [versión española por Pere Molera Solà y Marc J. Anglada Gomila] . - [1ª] ed. en español, reimp. Barcelona [etc.] : Reverté, 2007

*[Obs. docente: Se incluye también otra edición más actual.]*

**BB** Newell, James. Essentials of modern materials science and engineering / James Newell Hoboken : John Wiley & Sons, cop. 2009

**BB** Shackelford, James F.. Introducción a la ciencia de materiales para ingenieros / James F. Shackelford ; traducción, adaptación y revisión técnica, Alfredo Güemes, Nuria Martín . - 6ª ed., reimp.

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Madrid [etc.] : Pearson Prentice Hall, 2008

**BB** Smith, William F.. Fundamentos de la ciencia e ingeniería de materiales / William F. Smith ; traducción, Alicia Larena Pellejero . - 3ª ed. Madrid [etc.] : McGraw-Hill, D.L. 1998

**BC** Carraher, Charles E., Jr.. Carraher's Polymer Chemistry. 9th ed. Taylor & Francis. 2013

*[Obs. docente: Consultar con profesorado del departamento de Química Orgánica.]*

**BC** Fernández Carrasquilla, Javier. Ciencia de materiales / Javier Fernández Carrasquilla, José María Lasheras Esteban . - 2a. ed. San Sebastian : Editorial Donostiarra, D.L. 2001

**BC** Polímeros / Javier Areizaga...[et. al.] Madrid : Síntesis , D.L. 2002

**BC** Smart, Lesley. Solid state chemistry : an introduction / Lesley E. Smart, Elaine A. Moore . - 3rd ed. Boca Raton [etc.] : Taylor & Francis, cop. 2005