# 28819 - Materials Engineering

**Información del Plan Docente**

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| **Academic Year** | 2017/18 |
| **Faculty / School** | 175 - Escuela Universitaria Politécnica de La Almunia |
| **Degree** | 424 - Bachelor's Degree in Mechatronic Engineering |
| **ECTS** | 6.0 |
| **Year** | 2 |
| **Semester** | First semester |
| **Subject Type** | Compulsory |
| **Module** | --- |

## 1.General information

## 1.1.Introduction

## 1.2.Recommendations to take this course

## 1.3.Context and importance of this course in the degree

## 1.4.Activities and key dates

## 2.Learning goals

## 2.1.Learning goals

## 2.2.Importance of learning goals

## 3.Aims of the course and competences

## 3.1.Aims of the course

## 3.2.Competences

## 4.Assessment (1st and 2nd call)

## 4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

## 5.Methodology, learning tasks, syllabus and resources

## 5.1.Methodological overview

The learning process designed for this subject is based on the following: Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject Materials Engineering is conceived as a stand-alone combination of contents, yet organized into three

fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities.

The organization of teaching will be carried out using the following steps:

*1. Face-to-face generic activities:*

- **Theory Classes** : The theoretical concepts of the subject are explained.
- **Practical Classes** : Problems and practical cases are carried out.
- **Monitored Practices** : Exercices and practical cases are carried out, complementary to the theoretical concepts studied.

2. *Supervised Autonomous Activities* : These activities are carried out independently by students under the supervision of the teachers of the subject. The student will have questionnaires available per unit and suggested exercises and will be allowed to attend face-to-face or group tutorials to focus on solving them.
3. *Reinforcement activities* : Through the virtual learning portal (Moodle) or email of the University of Zaragoza, teachers of the subject will develop, for particular cases for which conventional tutoring can not be applied, support and help activities for students who need it solving doubts or providing solutions to problems connected with the units covered.

## 5.2.Learning tasks

**The programme offered to the student to help them achieve their target results is made up of the following activities...**

Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

- **Theory/Practice Lectures:** Theoretical activities or problems carried out mainly through exposition by the teacher.
- **Practical classes:** Theoretical discussion activities or exercices and practical cases presented by students
- **Practical laboratory testing:** This work is tutored by a teacher in laboratory. These activities will continue with an autonomous student work.
- **Individual tutorials:** These tutorials may be face-to-face or virtual (Moodle or email).
- **Group tutorials:** Scheduled tracking learning activities in which the teacher meets with a group of students to answer questions, exams or problems

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class. 40% of this work (60h) will be held in the classroom and or lab and the rest will be autonomous.

A summary of a weekly timetable guide can be seen in the following table.

| Activity | Weekly school hours |
|---|---|
| Lectures | 2-3 |
| Practical laboratory testing | 1-2 |
| Other Activities | 6 |

## 5.3.Syllabus

- **THEORETICAL CONTENT**

**UNIT 1. MATERIALS FOR ENGINEERING. PROPERTIES.**

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Types of materials for engineering. Classification of Materials based on Structure.Materials design and selection. Atomic Structure.Electronic structure of the atom. Atomic bonding.Mechanic, thermal, electric and magnetic properties.

**UNIT 2. MECHANICAL PROPERTIES, TEST AND FATIGUE.**

Stress and Strain.Solid solution hardening (alloying).Hardening mechanisms of materials.Precipiatation hardening. Polymorphic transformation.Hot working.Tensile, compression, shear, torsion , bending and hardness testing. Fatigue testing. Impact testing.Factors related to the selection of materials. Stress concentration.Cyclic stress. Stress-life (S-N) and factors that affect fatigue behavior.Crack formation, crack propagation and fracture.

**UNIT 3. ELECTRICAL, MAGNETIC AND OPTICAL PROPERTIES.**

Electrical resistivity and conductivity.Semiconductors and superconductors.Dielectric properties and polarization. Piezoelectricity and electrostriction. Ferromagnetic theory. Magnetic materials. Applications.Optical properties. Example of emmission.Material photonic interactions.

**UNIT 4. METALS. HEAT TREATING** .

Iron and steel products.Fe-C system.Fe-C alloys.Structural constituents.Role of alloying elements in the steels.Classification of steels and commercial forms. Effects of alloying in iron and steel.Heat treatment of steels. Annealing. Normalizing. Tempering. Hardening. Surface treatment systems. Surface hardening. Thermochemical treatments.Cementation. Nitriding.Cast iron. Classification of cast iron and cast alloys. Alloyed steels.Alloying elements. Classification. Metals and non-ferrous alloys (Aluminum. Magnesium. Titanium, Copper).Anti-friction alloys and refractory alloys.

**UNIT 5. CERAMIC MATERIALS.**

Classification.Crystalline ceramics. Characteristics. Study of the different ceramic materials: crystalline and/or refractory. Structural and electronic ceramic compounds. Glass.

**UNIT 6. POLYMERIC MATERIALS.**

Introduction. Structure in polymers and copolymers. Polymerization reactions.Classification based on structure. Effect of temperature on polymers. Elastomers (Rubbers) and plastics. Natural fibers. Artificial and synthetic fibers.

**UNIT 7. COMPOSITE AND HYBRIDS MATERIALS.**

Reinforced materials.Dispersion-strengthened composites.Particulate composites.Fiber-reinforced composites. Fiber-reinforced characteristics and composite matrix. Manufacturing techniques for reinforced composites. Laminar composite materials.Agglomerate compound materials .

**UNIDAD 8. CORROSION AND WEAR.**

Chemical corrosion.Electrochemical cell or battery. Types of electrochemical corrosion, propagation and protection. Oxidation. Radiation damage. Wear and erosion.

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- **PRACTICAL CONTENTS**

Most of the subjects in the section above have diffent situations and their posible solution. And some of them have practical laboratory testing. Next is a list of the test to be developed by the students in the laboratory in two hours sessions.

**Block I. Determination of mechanical characteristics. Destructive testing.**

1- Tensile Testing on metallic materials and polymers.

2- Hardness determination of metallic materials .

3- Determination of Shore hardness in plastics and elastomeric materials .

4- Impact testing . Resiliency

**Block II . Material properties . Inspection.**

1- Metallography

2- Ultrasonic testing

3- Liquid penetrant inspection.

4- Extensometry.

**Block III . Properties and characteristics of composite materials**

1- Porous materials density determination.

2- Cement Mechanical strength.

3- Fiber laminated composites testing

## 5.4.Course planning and calendar

For the students in continous evaluation system, the writen test will be held in the end of each section.
The final dates will be announced during the scholar year in the Moodle.

For the students in non-continous evaluation system a final test will take place the first day of the official test calendar.

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The dates of the final exams will be those that are officially published at http://www.eupla.es/secretaria/academica/examenes.html.

## 5.5.Bibliography and recommended resources

**The updated bibliography of the subject can be consulted through the library web page http://psfunizar7.unizar.es/br13/eBuscar.php?tipo=a "**


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| **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.. 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, 2012 |
| **BB** | Coca Rebollero, Pedro. Ciencia de materiales : teoría, ensayos, tratamientos / Pedro Coca Rebollero, Juan Rosique Jiménez . - [reimpr.] Madrid : Pirámide, 2000 |
| **BC** | Apraiz Barreiro, José. Tratamientos térmicos de los aceros / por José Apraiz Barreiro . - 10ª ed. Madrid : CIE Dossat 2000, D.L. 2002 |
| **BC** | Hellerich, Walter. Guía de materiales plásticos : propiedades, ensayos, parámetros, con 129 gráficas, 62 diagramas, 4 cuadros sinópticos y numerosas tablas / Walter Hellerich, Günther Harsch, Siegfried Haenle . - 5a. ed. en alemán, 1a. edición española Barcelona : Hanser, D.L. 1992 |
| **BC** | Miravete de Marco, Antonio;Larrode Pellicer,Emilio; Castejón Herrer, Luis. Materiales compuestos I y II/ Antonio Miravete, Emilio Larrode Pellicer, Luis Castejón Herrer.. - 1ª edición Zaragoza: Miravete de Marco, 2000 |
| **BC** | Otero Huerta, Enrique. Corrosión y degradación de materiales / Enrique Otero Huerta Madrid : Síntesis, 2001 |
| **BC** | Puertolas Ráfales, Jose Antonio.. Tecnología de materiales / José Antonio Puértolas Ráfales.. - 1ª edición Madrid : Síntesis, [2009]. |