Universidad Zaragoza

Year : 2019/20

30115 - Materials Engineering

Syllabus Information

Academic Year: 2019/20
Subject: 30115 - Materials Engineering
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
ECTS: 6.0
Year: 2
Semester: First semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

The principal aim of the subject is to get our students to acquire sufficient knowledge concerning both the concepts and those technical aspects linked to materials and applications in the area of Engineering.

1.2.Context and importance of this course in the degree

The subject of Engineering of Materials is part of the present curriculum of Industrial Organisational Engineering at the EUPLA. This subject lasts a semester and is taught in second year and consists of 6 ECTS credits. The subject is compulsory as it belongs to the teaching branch of Organisational Industrial Engineering.

The student must have a solid foundation concerning all those concepts developed in the subject in order to achieve a better understanding of the materials that can be used in each case, as well as their conformation techniques and as a result the modification of their properties with each type of processing in order to be able to pass the subjects in later academic years.

1.3.Recommendations to take this course

The subject Engineering of Materials has no prior compulsory requirements. However, students taking the degree in Organisational Industrial Engineering are advised to have passed, or at least have studied, Mathematics I and II as well as Physics I and II.

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

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

4.Methodology, learning tasks, syllabus and resources

4.1.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.

4.2.Learning tasks

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.
- **Practice session:** Theoretical discussion activities or exercises and practical cases presented by students
- **Practical laboratory sessions:** This work is tutored by a teacher in the laboratory. These activities will continue with 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

4.3.Syllabus

The course will address the following topics:

- **THEORETICAL CONTENT**

UNIT 1. MATERIALS FOR ENGINEERING. PROPERTIES.

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.

- **PRACTICAL CONTENTS**

Most of the subjects in the section above have different situations and their possible 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- Extensometry.

Block III. Properties and characteristics of composite materials

1- Porous materials density determination.

2- Cement Mechanical strength.

3- Fiber laminated composites testing

4.4.Course planning and calendar

For the students in the continuous evaluation system, the written test will be held at the end of each section.

The final dates will be announced during the scholar year in the Moodle.

The weekly schedule of the subject will be published at http://www.eupla.unizar.es/asuntos-academicos/calendario-y-horarios

The dates of the global evaluation test (**official calls**) will be published at http://eupla.unizar.es/asuntos-academicos/examenes

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=30115&year=2019