DEGREE CURRICULUM

MATERIALS SCIENCE

Coordination: CASANOVAS SALAS, JORDI

Academic year 2023-24

MATERIALS SCIENCE 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>MATERIALS SCIENCE</td></tr>
<tr><td>Code</td><td>102113</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Automation and Industrial Electronic Engineering</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Energy and Sustainability Engineering</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Mechanical Engineering</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Common branch in industrial engineering programs - Lleida</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Double bachelor's degree: Degree in Mechanical Engineering and Degree in Energy and Sustainability Engineering</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Programa Acadèmic de Recorregut Successiu - Enginyeries Industrials</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>3</td><td>3</td></tr>
<tr><td>Number of groups</td><td>3</td><td>3</td></tr>
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<tr><td>Coordination</td><td>CASANOVAS SALAS, JORDI</td></tr>
<tr><td>Department</td><td>ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>(40%) 60 h lectures
(60%) 90 h student work</td></tr>
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MATERIALS SCIENCE 2023-24

Important information on data processing	Consult this link for more information.
Language	Català

MATERIALS SCIENCE 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CASANOVAS SALAS, JORDI	jordi.casanovas@udl.cat	9	Arrange an individual appointment with the teacher
DAGO BUSQUETS, ANGELA	angela.dago@udl.cat	3	Arrange an individual appointment with the teacher
DAVID , CALIN ADRIAN	calinadrian.david@udl.cat	6	Arrange an individual appointment with the teacher

Subject's extra information

It is advisable 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.

There are not prerequisites for this course.

Learning objectives

- 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 parametres to characterize the properties.
- Understanding the relationship between internal structure and material properties

Competences

Cross-disciplinary competences

- **EPS1.** Capacity to solve problems and prepare and defence arguments inside the area of studies.
- **EPS7.** Capacity to work in situations with a lack of information and/or under pressure.

Specific competences

- **GEEIA9.** Knowledge of the basics of science, technology and chemistry of materials. Understand the relation between the microstructure, the synthesis or processing and the properties of the materials.
- **GEEIA14.** Knowledge and use of the principles of strength of materials.

Subject contents

MATERIALS SCIENCE 2023-24

1 Introduction

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

2 Crystal structure and non-crystalline structure

- 2.1 Introduction
- 2.2 Common crystal structures
- 2.3 Structural characteristics of polymers
- 2.4 Composites
- 2.5 Structural defects
- 2.6 Atomic diffusion

3 Mechanical properties

- 3.1 Laboratory tests: relation stress - strain
- 3.2 Elastic deformation and plastic deformation
- 3.3 Mechanical properties of polymers
- 3.4 Reinforcement techniques
- 3.5 Fracture and Fatigue

4 Electrical properties

- 4.1 Introduction
- 4.2 Band Theory
- 4.3 Metallic conductivity
- 4.4 Semiconductors
- 4.5 Conductivity in ceramics, polymers and composites

5 Magnetic properties

- 5.1 General concepts
- 5.2 Non-cooperative magnetic behavior: diamagnetism and paramagnetism
- 5.3 Cooperative magnetic behavior: ferro-, antiferro-and ferrimagnetism
- 5.4 Influence of temperature
- 5.5 Magnetic hysteresis cycle
- 5.6 Magnetically hard and soft materials
- 5.7 Superconductors

6 Optical and thermal properties

6.1 Thermal properties: heat capacity, thermal expansion and thermal conductivity

6.3 Optical properties of metallic and non-metallic materials

Methodology

- Lectures: introductory concepts and relevant theoretical results illustrated with examples and exercises
- Exercises: We solve exercises of increasing complexity in order to consolidate the concepts developed in the lectures. We propose exercises with real data to show the potential of the tools studied. The exercises are proposed and solved in small groups of students, thus promoting dialogue and participation.
- In addition, students are responsible for improving their knowledge though autonomous work, on the basis of the material provided or recommended by the teacher.

Development plan

Week	Methodology	Chapter	Classroom hours	Autonomous work (hours)
1-2	Lectures	Chapter 1	6	9
2-4	Lectures and exercises. Laboratory activity	Chapter 2	12	18
5-7	Lectures and exercises. Laboratory activity	Chapter 3	12	18
8-10	Lectures and exercises.	Chapter 4	12	18
11-13	Lectures and exercises.	Chapter 5	12	18
14-15	Lectures and exercises. Laboratory activity	Chapter 6	6	9

Evaluation

Block 1:

- Evaluation Activity 1 (AA1). Written exam, Topics 1-3. Final score percentage: 25%
- Evaluation Activity 2 (AA2). Written exam, Topics 1-6. Final score percentage: 50%

Block 2:

- Laboratory Activities. Final score percentage: 10%

Block 3:

- Multiple choice Tests. Final score percentage: 15%

- Recovery evaluation activity. Written exam, Topics 1-6. It allows to recover 75% of the Final score (equivalent to AA1+AA2)

- The possibility of carrying out an Alternative Evaluation is considered. This evaluation would take place on the same day as Evaluation Activity 2. It would consist of 2 parts: written exam similar to AA2 + additional exam of theoretical concepts

Bibliography

Recommended bibliography

- Callister W.D. y Rethwishch D.G. *Ciencia e Ingeniería delos Materiales*, 2ª Ed., Ed. Reverté S.A., Barcelona, 2016
- Shackelford J.F. *Introducción a la Ciencia de Materiales paraIngenieros*, 7ª Ed., Prentice Hall Iberia, Madrid, 2010.(follow the latest ediction)
- Shackelford J.F. *Introduction to Materials Science for Engineers*, Global Edition. Available from: VitalSource Bookshelf, (9th Edition). Pearson International Content, 2022.
- Smith W.F. y Hashemi J. , *Fundamentos de la Ciencia e Ingeniería deMateriales*, 5ª Ed., McGraw-Hill, 2014
- Montes J.M., Cuevas F.G. y Citas J. *Ciencia e Ingeniería de los Materiales*, Ediciones paraninfo, 2014

Other educational material: Campus Virtual: http://cv.udl.cat