Universitat de Lleida

DEGREE CURRICULUM

MATERIALS SCIENCE

Coordination: CASANOVAS SALAS, JORDI

Academic year 2019-20

Subject's general information

Subject name	MATERIALS SCIENCE
Code	102113
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Not informed	1	COMPULSORY	Attendance-based
Bachelor's Degree in Energy and Sustainability Engineering	1	COMPULSORY	Attendance-based
Bachelor's Degree in Mechanical Engineering	1	COMPULSORY	Attendance-based
Bachelor's Degree in Automation and Industrial Electronic Engineering	1	COMPULSORY	Attendance-based

Course number of credits (ECTS)	6
Type of activity, credits, and groups	

Activity type	PRAULA	TEORIA
Number of credits	3	3
Number of groups	3	3

Coordination	CASANOVAS SALAS, JORDI
Department	CHEMISTRY
Teaching load distribution between lectures and independent student work	(40%) 60 h lectures (60%) 90 h student work
Important information on data processing	Consult this link for more information.
Language	Català
Office and hour of attention	Jordi Casanovas Thursday 16h-18h / Office 2.14 (EPS) Josep Monné Thursday 17-18h i Dv. 18-19h / Office 2.14 (EPS)

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CASANOVAS SALAS, JORDI	jordi.casanovas@udl.cat	12	Tuesday 16-18h / Office 2.14 EPS
DAGO BUSQUETS, ANGELA	angela.dago@udl.cat	6	

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.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter

between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

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

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

2.3 Structural characteristics of polymers

2.4 Composites

2.5 Deviations from the ideal crystal structure

2.6 Diffusion phenomena

3 Mechanical properties

3.1 Laboratory tests: relation stress - strain

3.2 Elastic deformation and plastic deformation

3.3 Mechanical and thermomechanical 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, thermal conductivity

6.2 Thermal properties of polymers

6.3 Optical properties

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

7 Corrosion of Materials

7.1 Introduction

7.2 Atmospheric attack: oxidation

7.3 Electrochemical attack

7.4 Methods to prevent corrosion

Methodology

The activities will be divided into two parts that complement each other: lectures and exercices.

- Lecture: 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	Lectures	Tema 1	4	6
2-3	Lectures and exercises. Laboratory activity	Tema 2	8	12
4-5	Lectures and exercises.	Tema 3	8	12
6-8	Lectures and exercises. Laboratory activity	Tema 4	12	18
9-10	Lectures and exercises. Laboratory activity	Tema 5	8	12
11-12	Lectures and exercises.	Tema 6	8	12
13	Lectures and exercises. Laboratory activity	Tema 7	4	6
14	Lectures and exercises	Tema 8	4	6
15	Exercises	Review	4	6

Evaluation

- Evaluation Activity 1 (AA1). Written exam, Topics 1-3, Final score percentage: 25%
- Evaluation Activity 2 (AA2). Written exam, Topics 1-7, Final score percentage: 50%
- Laboratory Activities. Final score percentage: 10%
- Other Activities. Multiple choice Tests. Final score percentage: 15%

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

Bibliography

Recommended bibliography

- W.D. Callister y D.G. Rethwishch, "*Ciencia e Ingeniería delos Materiales"*, 2ª Ed., Ed. Reverté S.A., Barcelona, 2016
- J.F. Shackelford, "*Introducción a la Ciencia de Materiales paraIngenieros"*, 7ª Ed., Prentice Hall Iberia, Madrid, 2010
- W.F. Smith y J. Hashemi, "*Fundamentos de la Ciencia e Ingeniería deMateriales"*, 5ª Ed., McGraw-Hill, 2014
- J.M. Montes, F.G. Cuevas y J. Citas, "*Ciencia e Ingeniería de los Materiales"*, Ediciones paraninfo, 2014

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