COURSE DATA

Data Subject	
Code	34211
Name	Materials Science
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	First term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	11 - Chemical Industry	Obligatory

Coordination

Name	Department
IBAÑEZ PUCHADES, RAFAEL	320 - Inorganic Chemistry

SUMMARY

This subject tries to establish the bases to understand the relationship between the real structure (including amorphous materials, lattice defects and microstructure) and the properties of the materials. The application of phase and transformation diagrams of different types of materials is studied. The electronic structure of materials is described, which will be used for the interpretation of their electronic properties.

The transport, mechanical, electrical, magnetic and optical properties are studied, referring to the most relevant aspects of them for each type of material (metallic materials and alloys, ceramic materials, glass, polymer materials and composite materials).

Once the properties of each material have been studied, the subject will address their potential applications.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

This is a interdisplicinar subject, therefore it is related to all the subjects studied previously. It manage all the concepts studied in previous courses to interpret the relation between structure and properties of the different types of materials.

OUTCOMES

1108 - Degree in Chemistry

- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Demonstrate the ability to adapt to new situations.
- Interpret the variation of the characteristic properties of chemical elements according to the periodic table.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter Chemical Industry and that allow to acquire specific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject Materials Science related to the competences of the degree in Chemistry.

SPECIFIC KNOWLEDGE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Materials Science **that contemplate the learning outcomes EUROBACHELOR®**
The principal techniques of structural investigations, including spectroscopy	Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications..(CE7).
The characteristics of the different states of matter and the theories used to describe them.	Demonstrate knowledge of the characteristics and behaviour of the different states of matter and the theories used to describe them..(CE3).

COMPETENCES AND COGNITIVE SKILLS
The learning process should allow the degree graduates to demonstrate:

	Competences of the subject Materials Science **that contemplate the learning outcomes EUROBACHELOR®**
Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Ability to apply this knowledge and understanding to the solution of common qualitative and quantitative problems.	Solve qualitative and quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Ability to calculate and process data, related to information and chemistry data.	Solve qualitative and quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15).

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Materials Science **that contemplate the learning outcomes EUROBACHELOR®**
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	Solve problems effectively..(CG4). Solve qualitative and quantitative problems following previously developed models..(CE14). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily

	life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Ability to analyse materials and synthesize concepts.	Develop capacity for analysis, synthesis and critical thinking..(CG1). Show inductive and deductive reasoning ability..(CG2). Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration..(CB3).
Skills related to information technology such as word processing, spreadsheet, recording and storage of data, internet use related to the subjects.	Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT3).
Study skills necessary for professional development. These will include the ability to work autonomously.	Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation..(CG3). Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). Learn autonomously.(CG8). Demonstrate the ability to adapt to new situations..(CG9). Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.(CB5).

At the end of the course students should be able to

- Demonstrate ability to develop theoretical models and theoretical-experimental able to be used in the quantification of real systems, determining their validity and scope.

- Know the characteristics and significance of Chemical Industry.

- Projecting processing systems to obtain a final product according to given specifications.

- To acquire the minimum knowledge with which to understand the basis for the use of different materials in the industry, according to their physicochemical properties.

- Discriminate between different materials and choosing the most suitable according to the required performance technologically.

- Know the major industrial processes in the field of inorganic chemistry.

- Know the materials used in these processes and their manipulation at the source.

DESCRIPTION OF CONTENTS

1. Introduction

Material concept. Materials today: economic and environmental impact. Circular economy. Material design. Classification of materials.

2. Chemical bond and structure of the materials. Ideal solids

Bond in solids. Review of crystallography concepts. Compact packing structures. Structure of intermetallic compounds. Structure of inorganic solids.

3. Real solids

Defects in solids: Point defects. Linear defects. Extensive defects. Amorphous solids: Glasses, Polymers.

4. Phase diagrams

System, phase and component. Chemical potential and equilibrium between phases. The Gibbs phase rule.
Binary diagrams. Phase diagrams and microstructure of alloys. Introduction to the diagrams of three components: Composition plan and sections.

5. Kinetics and reactivity

Diffusion, laws of diffusion. Kinetics of phase transformations in metals and alloys. Phase transformations in ceramics and glass. Metallic corrosion.

6. Transport properties

Heat transport. Mass transport.

7. Mechanical properties of materials

Elastic deformation. Plastic deformation and movement of dislocations. Hardening mechanisms. Fracture and fatigue. Mechanical properties of glass and ceramics. Mechanical properties of plastics.

8. Electrical properties

Classification of materials based on their electrical properties. Electrical properties of metals. Band Theory. Semiconductors. Intrinsic and extrinsic semiconductors. Photoelectric effect and photovoltaic materials. Electrical properties of ceramics. Electrical properties of polymers.

9. Magnetic properties

Introduction: Magnetic fields, magnetic induction and magnetization. Diamagnetism and paramagnetism. Magnetic domains: Ferromagnetism, antiferromagnetism and ferrimagnetism. Magnetic susceptibility and temperature.

10. Optical properties

Interaction of light with matter: Reflection, absorption and transmission. Absorption, emission and excitation spectra. Reflection and refraction. Transparency and opacity. Optical fibers. Electroluminescent diodes (LED's), Laser emission: Types of lasers.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	51,00	100
Tutorials	9,00	100
Study and independent work	70,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

This subject is designed so that students lead their own learning and is structured in the following components:

Lectures.- In these classes the lecturer will provide an overview of the topic under study with special emphasis on new aspects or on those particularly complex. Lessons will also involve the specific application of the knowledge acquired by students via the resolution of questions and practical problems that students have previously worked on. Logically, these classes must be complemented with individual study.

Group tutorials.- Students will come to them in smaller groups. For the development of the tutoring sessions the teacher will propose a set of exercises and questions in advance according to the program of each tutoring. In the face-to-face sessions, these questions will be reviewed and any doubts raised will be resolved.

EVALUATION

The knowledge acquired will be evaluated by an examination, in the periods established by the Faculty, which will make the largest contribution to the final grade.

The examination will consist of objective questions, dedicated to those knowledge considered as basic and of numerical and relationship problems that require to contemplate aspects of the subject that appear in different tòpics. Students who do not pass in the first call must take the second exam.

The student's participation in any activity proposed, related to the subject, can be positively assessed, including:

• Problems and qüestions solving.

• Participation in discussions and seminars.

• Content or coursework making.

The overall note will be that of the exam plus the one obtained in all the activities raised, with the weight that each teacher establishes and communicates at the beginning of the course.

To approve the subject, a minimum grade of 5 must be reached in each of the evaluation sections.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

Basic

- Callister, W. D. J.; Rethwisch, D. G. Materials Science and Engineering: An Introduction (SI Version), 10th, Glob ed.; John Wiley & Sons, 2020.
- Callister, W. D.; Rethwisch, D. G. Ciencia e Ingeniería de Materiales; Reverte, 2016.
- Mitchell, B. S. An Introduction to Materials Engineering and Science for Chemical and Materials Engineers; Wiley: Hoboken, NJ, 2004. https://links.uv.es/materiales/Mitchell
- Smith, William & Hashemi, J. Fundamentos de La Ciencia e Ingenieria de Materiales; 2006. https://links.uv.es/materiales/Smith
- Ashby, M. F.; Scherclif, H.; Cebon, D. Materials: Engineering, Science, Processing and Design, 3td ed.; Elsevier Science, 2014. https://links.uv.es/materiales/Ashby
- Carter, C. B.; Norton, G. Ceramic Materials: Science and Engineering; Springer: New York, Heidelberg, 2013. https://links.uv.es/materiales/Norton

Additional

- West, A. R. Solid State Chemistry and Its Applications; John Wiley & Sons, Inc.: Chichester, West Sussex, 2014. (Chapter 2). B. Ciències Planta1 - SalaB CI 54 WES
- Hoffman, R.; Solids and Surfaces. A Chemist´s View of Bonding in Extended Structures, 1ª Ed. New York, 1988, Willey-VCH, ISBN-13: 978-0471187103. B. Ciències, Planta1 - SalaB CI 544.1 HOF
- Donald E. Sands, Introducción a la Cristalografía, Ed. Reverté, 1971, B. Ciències Planta1 - SalaB CI 548 SAN