VNIVERSITAT DE VALÈNCIA

Course Guide
34757 Materials science I

COURSE DATA

Data Subject	
Code	34757
Name	Materials science I
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	11 - Equipment materials and design	Obligatory

Coordination

Name	Department
AMOROS DEL TORO, PEDRO JOSE	320 - Inorganic Chemistry

SUMMARY

Materials Science and Equipment Design seeks to set out basic principles and procedures for carrying out the mechanical design of equipment and facilities. Look for foundations to choose the right material for every industrial equipment, depending on the chemicals that come into contact with them and the environment that will support them and working conditions. Also the practical application of basic design principles, the various equipment and systems in industrial chemical plant. In this course, "Materials Science I" deals with the basic principles of structure, binding and reactivity of solids, applied to the study of different types of materials: metals and alloys, ceramics, glasses, polymers, and composites. The subject of Materials Science I is a compulsory subject taught in the second degree course in Chemical Engineering in the first quarter. The curriculum of the University of Valencia has a total of 6 ECTS. The aim of this course is that the students acquire the basic knowledge of Science of Materials for the study, design and/or operation of the most common in the chemical industry. The course contents are: Chemistry, synthesis and processing of materials. Structural types and their characteristics. Properties and applications of metallic materials, ceramics, glasses, polymers, and composites. The general objectives of the course are: To make known to the student the structure, binding and reactivity of different types of materials. To familiarize the student with the properties of different types of materials, and the factors influencing them.

Observations: The theory classes will be taught in Spanish and practical and laboratory classes as stated in the course sheet available on the website of the degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Knowledge relevant to the subject of Chemistry I.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- R3 - Knowledge of materials science, technology and chemistry fundamentals. Understand the relationship between microstructure, synthesis or processing and the properties of materials.
- R8 - Knowledge and use of the fundamentals of the strength of materials.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

Learning Outcomes

• To understand the relationship of the microscopic structure, the type of chemical bonds, the synthesis and processing with the properties and characteristics of materials. (G3, G4, R3)
• To know the properties (chemical, mechanical, thermal and electrical) and industrial applications of different types of materials: ceramic, metal, glass, polymers, and composites and their degradation processes, lifetime of use and potential applications. (G3, G4, R8)

To acquire skills

The student should be able to:
• Distinguish different types of materials on the basis of their properties.
• Choose the type of material for a particular application.
• Understand the structures of solids, as well as distinguishing different types of structures.
• Determine the mechanical parameters that characterize the mechanical behavior of a material.
• Know how to control and improve the mechanical properties of metals.

• Know how to analyze the electrical behavior of a material and its possible applications.
• Know how to select the type and dosage of raw materials needed for the preparation of different types of ceramic materials.
• Know the factors that determine the final properties of a ceramic material as a function of its processing conditions.
• Understand the process of formation of a glass and the parameters that influence in it.
• Know how to determine the crystallinity of a polymer.
• Know the procedures for determining the molecular weight of a polymer.
• Know the more important types of polymer synthesis.
• Understand the importance of miscibility in polymer applications.
• Know the basis for the design of composites.

DESCRIPTION OF CONTENTS

1. INTRODUCTION

Historical perspective. Classification of materials. New materials.

2. EXTENSION AND REVISION OF BASIC CONCEPTS

Bond in solids.

3. EXTENSION AND REVISION OF BASIC CONCEPTS

Structure of solids. Ordered and disordered materials. Packing of atoms/ions in solids. Types of structures. Crystallographic planes, slip systems.

4. DEFECTS

Imperfections in solids. Crystalline defects.

5. DIFFUSION

Diffusion in solids. Mechanisms of diffusion in solids.

6. METALS AND METAL ALLOYS

Metallic materials: metals, alloys, intermetallic compounds. Mechanical Properties of Metals: Tension, compression, shear and torsion. Elastic deformation and plastic deformation. Failure: types of fracture. Fatigue. Hardness: Mechanisms of hardening. Electrical properties. Conductivity: electronic conductivity. Band structure on solids. Semiconductors: Types, devices. Alloys: Definitions and basic concepts: components, systems, solubility limit, phase, etc.. Isomorphic binary systems: Ni-Cu alloy. Development

of microstructures. Mechanical properties of isomorphic alloys. Eutectic binary systems: Cu-Ag, Pb-Sn. Development of microstructures. Fe-Carbon System. Steels: Types and properties.

7. CERAMIC MATERIALS AND GLASS

Concept of ceramic material. Classification of ceramics. Raw Materials: Formulation and composition. Rheology. Stages of the ceramic process. Composition of fired ceramic material. Ceramic Glazes: Raw materials, formulation and composition. Firing process and properties. Ceramic colorants. Advanced ceramics. Mechanical, thermal and electrical ceramics. Characteristics of the glassy state. Definition of glass. Glass forming process. Glass transition temperature. Components of the glass. Good and bad glass formers. Types of glasses. Raw materials for glass manufacturing. Glass processing. Optical fiber: Operation principle. Properties. Applications.

8. POLYMERIC MATERIALS

Concept of polymer: organic polymers, inorganic polymers. Molecular weight and degree of polymerization. Molecular structure of polymers: linear polymers, branched polymers, crosslinked polymers. Copolymers. Configurations. Crystallinity. Polymerization reactions: Synthesis of polymers. Most important polymers and their applications. Properties of polymers.

9. COMPOSITES

Types of composites. Principle of combined action: Matrix and dispersed phase. Reinforced materials: reinforced with particles and reinforced with fibers. Structural materials. Influence of design. Methods of processing of composites. Calculations in composites.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	40,00	100
Classroom practices	20,00	100
Development of individual work	5,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	25,00	0
Preparation of practical classes and problem	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

• Lectures.- In these classes the professor will give an overview of the topic under study with special emphasis on new aspects or special complexity. Logically, these classes are supplemented by personal study time indicated as non-contact hours.(G3, G4, R3, R8)
• Classes of problems.- In these classes it will be carried out the specific application of knowledges which students have acquired in the lectures. Students must previously work on the problems to be solved in the class. Solving these problems will be held at times by the teacher and otherwise by the students, either in group or individually.(G3, G4, R3, R8)

EVALUATION

Option a.- Continuous assessment through written tests (G3, G4, R3, R8). There will be two tests: the first will correspond to topics 1 to 5 of the program and the second to topics 6 to 9. The date for carrying them out is in the schedule of the subject. The tests will allow to eliminate contents if a score higher than 4 out of 10 is obtained, however, the subject will be only passed whether the average of the two tests is 5 or higher.

Additionally, deliveries and Moodle-type questionnaires (either during class time or as extra work) on a topic or set of topics will be carried out. The scores obtained in these exercises may count up to 30% of the score of the two tests mentioned above.

Class attendance and active participation may be viewed positively in the final score (G3, G4, R3, R8).

Option b.- Final exam. It will be applied to students who have not passed the subjects in option a. In this case, the exam score will be limited to a maximum of 8 out of 10 (G3, G4, R3, R8), being able to assess up to 2 points for class attendance and/or active participation.

The subject is considered overcome when the mark obtained is equal to or greater than 5 (over 10).

“In any case, the evaluation system will be governed by what is established in the Evaluation and Qualification Regulations of the Universitat de València for Degrees and Masters (http://links.uv.es/7S40pjF).

REFERENCES

Basic

- Ciencia e Ingeniería de Materiales. W. D. Callister y D. G. Rethwisch. 2º Edición castellano (9º edición original). Editorial Reverté.

Additional

- Introducción a la Ciencia de Materiales para Ingenieros, James F. Shackelford, ed. Pearson, 2005. ebook en UV
- Ciencia e ingeniería de los materiales, Donald Askeland y Pradeep P. Phule, Cengage Learning Editores, 2004.
- Química del estado sólido. Una introducción. Smart, L., Moore, E. Addison-Wesley Iberoamericana, Wilmington, 1995.
- Sólidos Inorgánicos. D. M. Adams. Alhambra Universidad, 1986.