COURSE DATA

DATA SUBJECT

Code: 34757
Name: Materials science I
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	Escola Tècnica Superior d'Enginyeria	2	First quarter

SUBJECT-MATTER

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

COORDINATION

AMOROS DEL TORO PEDRO JOSE

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.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It is recommended that knowledge relevant to the subject of Chemistry I.

COMPETENCES / LEARNING OUTCOMES

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Acquire knowledge of basic and technological subjects to facilitate the learning of new methods and theories, and develop the versatility to adapt to new situations.

Act autonomously in learning, make informed decisions in different contexts, issue judgements based on experimentation and analysis and transfer knowledge to new situations.

Knowledge and use of the principles of strength of materials.

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Solve problems with initiative, make decisions, think creatively and critically, and communicate and convey knowledge, skills and competences in the field of industrial engineering.

Understand the fundamentals of materials science, technology and chemistry, and relate microstructure, synthesis or processing to material properties.

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

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	40,00
Classroom practices	20,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	5,00
Independent study and work	20,00
Preparation of lessons	45,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

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.
- 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.

EVALUATION

Subject Assessment System

In the first examination session, the subject will be assessed through continuous assessment and by means of a final objective test on the official examination date.

Continuous assessment: This consists of completing and submitting activities/exercises, which cannot be retaken, in which the theoretical concepts studied in class are applied. These activities must be completed remotely and submitted via the Virtual Classroom of the University of Valencia.
Objective test: This consists of an exam made up of theoretical questions and exercises. To pass this test, the student must obtain a mark of at least 4 out of 10.

The final grade will be calculated as follows: the average grade of the submitted activities (20%) and the grade of the objective test (80%).

The minimum grade required to pass the subject is 5 out of 10. If the objective test is not passed with a mark of at least 4 out of 10, the final grade will be the mark obtained in the objective test.

In the second examination session, the subject will be assessed in the same way as described for the first session: the grades for the submitted activities (20%) will be retained, and the objective test (which must be passed with a minimum grade of 4 out of 10) will count for 80%. The minimum grade required to pass is 5 out of 10. Optionally, the objective test may be considered as the sole assessment element in the second session.

Any clear case of copying or plagiarism in any activity that forms part of the assessment will result in the impossibility of passing the subject, and the student will subsequently be subject to the appropriate disciplinary procedures as indicated in the PROTOCOL FOR ACTION AGAINST FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020). In any case, the assessment system will be governed by the provisions of the Regulations on assessment and grading of the University of Valencia for undergraduate and master's degrees (ACGUV 108/2017)

REFERENCES

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