COURSE PROGRAM

Academic Year: 2024/2025

Identification and characteristics of the course					
Code	501859			ECTS Credits	6
Course name (English)	Materials Science				
Course name (Spanish)	Ciencia de Materiales				
Degree programs	Degree in Chemistry				
Faculty/School	Faculty of Sciences				
Semester	8	Type of course	Compulsory		
Module	Complementary				
Matter	Materials Science				
Lecturer/s					
Name		Office	E-mail		Web page
Francisco Luna Giles		1st Floor Chemistry Building (J.M. Viguera Lobo)	pacoluna@unex.es		
Emilio Viñuelas Zahínos			emilvin@unex.es		
Subject Area	Inorganic Chemistry				
Department	Organic and Inorganic Chemistry				
Coordinating Lecturer (If more than one)	Emilio Viñuelas Zahínos				

Competencies

Basic Competences

CB1: Students should be able to show that they possess and comprehend facts and contents in an area of study which, based on a previous general secondary school level, have been extended to those included in advanced textbooks and in some aspects proceed from the most advanced studies in the area.

CB2: Students should be able to show that they have learned how to apply their knowledge professionally to their future jobs or tasks and that they possess the competences needed to develop and defend arguments and solve problems in the area of study

CB3: Students should be able to show that they are capable of collecting and interpreting the relevant data (normally within their area of study) needed for formulating judgments which require critical thought on social, scientific and ethical topics of relevance.

CB4: Students should be able to show that they are able to transmit information, ideas, problems and solutions both to specialized and non-specialized publics.

CB5: Students should be able to show that they have developed the learning skills required to perform further studies with a high degree of self-dependence.

General Competences

CG1: Students should be able to engage intellectually stimulating and fulfilling tasks along the learning process.

CG2: Students should be able to develop and make grow their interest in learning chemistry and to assess its importance in scientific, industrial, economic, environmental and social contexts.

CG3: Students should be able to have a sound and balanced background on chemical knowledge as well as practical skills to allow them to work on a chemical laboratory safely and reliably.

CG4: Students should be able to develop their proficiency and aptitude towards the understanding, interpretation, application and (oral and written) communication of their knowledge and skills.

Transversal competences

CT1: Skills of: a) Correctly using the inductive reasoning and developing new ideas. b) Analysis and synthesis. c) Organization and planning. d) Working in international contexts. e) Oral and written communication. f) Critical rationalism. Problem solving. g) Decisions making. h) Group work (including interdisciplinary groups) and leadership skills to be able to supervise and also execute jobs both in chemical laboratories and complex industrial settings.

CT2: Communication skills to clearly and precisely express knowledge and conclusions to both experts and general audiences.

CT3: Ability of learning new techniques and knowledge, allowing to perform new studies with a high autonomy level.

CT4: Developing independent learning proficiency. Improving relational capacity, leadership aptitude, and creativity and adaptation skills.

CT5: Showing sensitivity towards environmental issues.

CT6: Showing recognition of diversity and multiculturalism.

CT7: To respect the fundamental rights and equality of men and women, and to acquire an ethic compromise of respect to life and natural environment.

CT8: To show quality assurance concern.

CT10: Ability of using the most relevant information and communication technologies (ICT's) according to the circumstances.

Specific competences

CE14: Ability of distinguishing materials and deducing their properties.

CE24: Ability of using the most relevant information and communication technologies (ICT's) according to the circumstances.

Contents

Course outline

Study of the relationship between the structure of materials and their properties. Processing of materials to modify structure. Structure deduction from phase diagrams and T.T.T. diagrams.
Study of types of materials (metals, ceramics, polymers, composites) and selection for technological applications. Deterioration and protection in the use of materials.

Course syllabus
Name of lesson 1: Introduction to Materials Science. Contents of lesson 1: Introduction. Classification of materials. Selection of materials.
Name of lesson 2: Defects in materials. Contents of lesson 2: Introduction. Types of defects. Point defects. Solid solutions. Linear defects. Surface defects.
Name of lesson 3: Thermodynamics. Phase diagrams. Contents of lesson 3: Introduction: Phase rule. Methods for constructing phase diagrams: Cooling curves. Binary phase diagrams: Lever rule. Description of the practical activities of lesson 3: Application of case studies. Construction of phase diagrams from experimental data.
Name of lesson 4: Kinetics of phase transformations. Heat treatments. Contents of lesson 4: Introduction: The time factor in phase transitions. Materials processing: Heat treatments. Isothermal transformation diagrams. Anisothermal diagrams (continuous cooling curves) in relation to isothermal ones (T. T. T. diagrams). Precipitation hardening. Deformation hardening.
Name of lesson 5: Metallic materials. Contents of lesson 5: Mechanical properties of metals. Processing. Most used alloys and metals. Description of the practical activities of lesson 5: Obtaining metallic materials in the laboratory. Hardness measurements
Name of lesson 6: Ceramic materials. Contents of lesson 6: Introduction. Crystalline ceramics. Glass. Glass ceramics. Mechanical, thermal and optical properties. Ceramic processing.
Name of lesson 7: Polymeric Materials. Contents of lesson 7: Introduction. Some properties and characteristics of polymers. Applications and conformation of polymers. Description of the practical activities of lesson 7: Obtaining polymeric materials in the laboratory.
Name of lesson 8: Composite materials. Contents of lesson 8: Introduction. Composite materials with fibers. Particulate composites. Structural composites. Natural composite materials. Forming of composite materials. Description of the practical activities of lesson 8: Composite materials analysis
Name of lesson 9: Biological materials and biomaterials. Contents of lesson 9: Introduction. Biological materials: bones, cartilage, tendons and ligaments. Biomaterials: metals, ceramics, polymers and composites in biomedical applications.
Name of lesson 10: Degradation and failure of materials. Contents of lesson 10: Introduction. Different corrosion processes. Corrosion control. Degradation of polymeric materials. Degradation of ceramic materials.

Educational activities								
Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	Total	L	HI	LAB	COM	SEM	SGT	PS
1	5	2						3
2	19	4		3				12
3	21	5						16
4	18	4						14
5	23	5		6				12
6	16	5						11
7	18	5		4				7
8	9	4		2				5
9	8	3						5
10	9	4						5
Assessment								
TOTAL								

L: Lectures (85 students)
HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (20 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching Methodologies

1. Lectures of theory and problems.
2. Resolution, analysis and discussion of proposed practical problems.
4. Learning based on experimentation.
5. Tutoring in small groups orients the student in their learning.
6. Autonomous learning.
7. Evaluation.

Learning outcomes

To be able to categorize materials from the properties presented.
To be able to select the material type and the specific material for an application from its design parameters and cost.
To be able to understand and know how to deduce data of practical interest from diagrams and graphs related to materials, such as phase diagrams, isothermal transformation diagrams or cooling curves, which indicate the conditions of use and existence of materials.
To be able to choose thermal or mechanical operations that can improve the properties of materials for their technological applications.
To be able to observe texture and microconstituents in order to learn to deduce the "history" (solidification conditions and subsequent treatments) of the sample, predict physical and mechanical properties and deduce composition.

To show handling of the instruments used in laboratory practices.

Assessment systems

For the evaluation of the course, what is established in the current Regulations of Evaluation of the Official Undergraduate and Master's Degrees of the University of Extremadura will be taken into account.

The final grade of the course will be obtained:

Ordinary call (JUNE):

Option 1: Continuous evaluation mode.

1. 75% of the final grade will come from the grade obtained in the final written test (date decided by the Sciences Faculty Council).
2. 15% of the final grade will come from the grade obtained in the preparation of a work on a topic and its oral presentation in class. These activities are not recoverable.
3. 10% of the final grade will come from the grade obtained in the practical part. The qualification of the practical part will come from questionnaires that will be made before the beginning of each laboratory practice or from the delivery of laboratory reports. These activities are not recoverable.

Attendance to the laboratory practices is compulsory. Those who, in its case, have not properly justified the absences of attendance will have to make a practical exam in the laboratory whose overcoming is essential to pass the subject.

To pass by continuous evaluation the final written test should be graded with at least 4.0 points

Option 2: Global evaluation mode: It will be evaluated exclusively by means of a theoretical/practical test (date decided by the Sciences Faculty Council).

The choice of the global evaluation mode corresponds to the students, who will be able to carry it out during the first quarter of the semester (or until the last day of the registration extension period if it ends after that period), through a specific space created for it in the Virtual Campus. In the absence of express request by the student, the assigned mode will be that of continuous evaluation.

Extraordinary calls

It will be evaluated exclusively by means of a theoretical/practical test (date decided by the Sciences Faculty Council).

Bibliography (basic and complementary)

- Askeland, D. R., "The Science and Engineering of Materials", 3th ed, Springer, 1996.
- Avner, S. H., "Introduction to Physical Metallurgy", 2nd ed, Ed. McGraw Hill, 1974.
- Callister, W. D., Jr. & Rethwish, D. G." Materials Science and Engineering", 10th ed, Wiley, 2018.
- Mangonon, Pat L., "The principles of Materials Selection for Engineering Design", Prentice Hall, 1998.

- Shackelford, J. F., "Introduction to Materials Science for Engineers", 8th ed., Pearson Prentice Hall, 2015.
- Smallman, R.E. y Bishop, R. J., "Modern Physical Metallurgy & Materials Engineering" 6th ed., Butterworth-Heinemann, 1999.
- Smith, W. F., Hashemi, J., "Foundations of Materials Science and Engineering", 6th ed, Ed. McGraw-Hill, 2019.

Other resources and complementary educational materials

Practical Handbook can be downloaded from the UEx Virtual Campus: http://campusvirtual.unex.es/