UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: SCIENCE OF MATERIALS
Type: CORE COURSE
Degree: 409 - CHEMISTRY
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
Year: 4
Main language: Spanish
Use of additional languages:
Web site:

Code: 57327
ECTS credits: 6
Academic year: 2022-23
Group(s): 20
Duration: First semester
Second language:
English Friendly: Y
Bilingual: N

Lecturer: **MIGUEL ANGEL ARRANZ MONGE** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
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Lecturer: **CARLOS JESUS SANCHEZ JIMENEZ** - Group(s): **20**

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2. Pre-Requisites

To have previously passed the basic module.

3. Justification in the curriculum, relation to other subjects and to the profession

The use and continuous development of new materials in today's society leads to the need to know in detail its fundamental characteristics and technical features. In this subject, the internal structure and different properties of metallic, ceramic, polymeric materials are studied. All of them are frequently used in the different areas of the Degree of Chemistry, both in applications and fundamental research. Due to the object of study of Materials Science, its relationship with other subjects of this Degree is very broad: structure and electrical properties of polymers (organic chemistry), metals and ionic conductors (inorganic chemistry), diagrams and phase transitions (Thermodynamics Chemistry), mechanical properties of materials (Chemical Engineering), ... This subject is particularly useful also for the technical field, since it allows us to select the appropriate materials for each industrial application, or know and control the framework where different phenomena are developed by chemists in advanced research.

4. Degree competences achieved in this course

Course competences

Code	Description
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
E17	Develop the ability to relate to each other the different specialties of Chemistry, as well as this one with other disciplines (interdisciplinary character)
G02	Be able to gather and interpret data, information and relevant results, obtain conclusions and issue reasoned reports on scientific, technological or other problems that require the use of chemical tools
G05	Acquire and adapt new knowledge and techniques of any scientific-technical discipline with incidence in the chemical field
T03	Proper oral and written communication
T07	Ability to work as a team and, where appropriate, exercise leadership functions, fostering the entrepreneurial character
T10	Ability to use specific software for chemistry at user level
T11	Ability to obtain bibliographic information, including Internet resources

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Be able to interpret phase diagrams (solidification, defects, diffusion)

Know the most relevant properties of metallic materials: mechanical, electrical and magnetic transport properties

Know the properties and methods of steel manufacturing.

To develop in the student the capacity of initiative to pose and solve concrete problems of the Industry, as well as to interpret the obtained

Learn to develop topics and acquire skills in the oral and written exposition at the time of the presentation of the results, developing their ability to work as a team

To know in detail the magnetism in metallic materials and the different magnetic orders (ferromagnetism, ferrimagnetism, antiferromagnetism) and their modern technological applications

Know in detail the manufacturing process of ceramic materials, their typologies and most important properties

Know the concept, classification and properties of minerals, highlighting their applications to the ceramic industry

Know the concept, classification and properties of polymers, highlighting their applications in the industry.

6. Units / Contents

Unit 1: Introduction

Unit 2: The microscopic structure of solids

Unit 3: Mechanical properties of materials (metals)

- **Unit 3.1** Elasticity
- **Unit 3.2** Plasticity
- **Unit 3.3** Fracture

Unit 4: Phase diagrams

- **Unit 4.1** Definitions
- **Unit 4.2** Binary diagrams

Unit 5: Applications and processing of metals and metal alloys

Unit 6: Other properties of metals

- **Unit 6.1** Electrical
- **Unit 6.2** Thermal
- **Unit 6.3** Magnetic
- **Unit 6.4** Optical

Unit 7: Ceramic materials. Definition. Classification. Ceramic structure.

Unit 8: Silicate ceramics. Structure and classification of silicates. The silicates as ceramic raw material.

Unit 9: Methods of characterization of ceramic materials. X-ray diffraction. Thermal methods. Physical, chemical and mechanical analysis.

Unit 10: Ceramic clay products. Classification of baked clay products. Technique and manufacturing processes.

Unit 11: Refractory ceramic materials. Refractory clay. Refractory silica. Other refractory materials

Unit 12: Abrasive materials and advanced ceramics.

Unit 13: Cements and binders. Plasters. Limes. Concrete and other compounds with cement.

Unit 14: Glasses. Definition and properties. Manufacture of glasses. Vitreous ceramics.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CB03 CB05 E17 G02 G05	1.2	30	N	-	
Workshops or seminars [ON-SITE]	Problem solving and exercises	CB03 CB05 T03 T07 T10 T11	0.8	20	Y	N	
Writing of reports or projects [OFF-SITE]	Case Studies	CB03 CB05 T03 T07 T10 T11	2.7	67.5	Y	N	
Study and Exam Preparation [OFF-SITE]	Self-study	CB03 CB05 T03 T07 T10 T11	1	25	N	-	
Mid-term test [ON-SITE]	Assessment tests	CB03 CB05 E17 G02 G05 T03 T07 T10 T11	0.3	7.5	Y	Y	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.3					**Total class time hours: 57.5**
		Total credits of out of class work: 3.7					**Total hours of out of class work: 92.5**

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Mid-term tests	70.00%	100.00%	The subject is divided into two blocks with theoretical and practical contents (exercises). The teacher of each block will indicate in detail the weight of the different sections for the evaluation of the written test or exam.
Assessment of problem solving and/or case studies	30.00%	0.00%	Depending on the teacher of each block of the subject, the number of interested students and the time available, the resolution and presentation of practical cases by the student will be proposed. These activities will be voluntary and their correct execution may suppose between 10-30% of the total (according to the teacher's criteria to be detailed in the first classes). For those students not interested in these training activities, this percentage will be added to the final test
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The exam is divided into two parts: metallic materials (subjects 1-6) and ceramic and polymeric materials (subjects 7-15), which will be evaluated on different dates.

For the evaluation of each part there will be a written test that will consist of theoretical and practical questions, related to the content of the lectures and the practical exercises solved in class, respectively. The proportion or importance of these questions in each part will depend on the teacher and will be detailed at the beginning of classes. The maximum score in each exam will be 8 points with a required minimum of 4 points to pass each exam, and

consequently, to add the the grade obtained in the other practical activities or talks (maximum of 2 points).
Subsequently, the mark of the complete subject will be the average of the results obtained in the two parts, provided that each of them exceeds a minimum of 5 points out of 10.
In case of passing only a part of the complete exam, it can be eliminated for the extraordinary call.

Non-continuous evaluation:

On the official date of the ordinary call, the two written tests will be carried out jointly, corresponding to the blocks of the subject. The grade and percentage of the activities carried out during the continuous evaluation (2 points / 20%) will be replaced by additional theoretical questions about the contents of the subject.

Specifications for the resit/retake exam:

Students who have not passed the ordinary call must attend the extraordinary call. According to what they consider, the student can take the full exam to re-evaluate the whole subject, or only the failed part. In this extraordinary call, the same evaluation criteria will be maintained as in the ordinary exam, as well as the exam format (type of questions or exercises).

Specifications for the second resit / retake exam:

The evaluation criteria will be applied the same as in the ordinary call.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

Unit 1 (de 14): Introduction

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 2 (de 14): The microscopic structure of solids

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	1
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 3 (de 14): Mechanical properties of materials (metals)

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	3
Writing of reports or projects [AUTÓNOMA][Case Studies]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 4 (de 14): Phase diagrams

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	4
Writing of reports or projects [AUTÓNOMA][Case Studies]	7
Study and Exam Preparation [AUTÓNOMA][Self-study]	3

Unit 5 (de 14): Applications and processing of metals and metal alloys

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 6 (de 14): Other properties of metals

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	2
Mid-term test [PRESENCIAL][Assessment tests]	4

Unit 7 (de 14): Ceramic materials. Definition. Classification. Ceramic structure.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1

Unit 8 (de 14): Silicate ceramics. Structure and classification of silicates. The silicates as ceramic raw material.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1

Unit 9 (de 14): Methods of characterization of ceramic materials. X-ray diffraction. Thermal methods. Physical, chemical and mechanical analysis.

Activities	**Hours**
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	8
Writing of reports or projects [AUTÓNOMA][Case Studies]	9.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	3

Unit 10 (de 14): Ceramic clay products. Classification of baked clay products. Technique and manufacturing processes.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3

Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1

Unit 11 (de 14): Refractory ceramic materials. Refractory clay. Refractory silica. Other refractory materials	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1

Unit 12 (de 14): Abrasive materials and advanced ceramics.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 13 (de 14): Cements and binders. Plasters. Limes. Concrete and other compounds with cement.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	2

Unit 14 (de 14): Glasses. Definition and properties. Manufacture of glasses. Vitreous ceramics.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Writing of reports or projects [AUTÓNOMA][Case Studies]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1
Mid-term test [PRESENCIAL][Assessment tests]	3.5

Global activity	
Activities	**hours**
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	20
Writing of reports or projects [AUTÓNOMA][Case Studies]	67.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	25
Mid-term test [PRESENCIAL][Assessment tests]	7.5
Class Attendance (theory) [PRESENCIAL][Lectures]	30
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Donald R. Askeland, Frank Haddleton, Phil Green, Howard Robertson	The Science and Engineering of Materials	Springer		1489928952	2013	
JUAN MANUEL MONTES MARTOS, FRANCISCO GÓMEZ CUEVAS y JESÚS CINTAS FÍSICO	Ciencia e ingeniería de los materiales	Paraninfo		9788428330176	2014	
William D. Callister	Materials Science and Engineering: An Introduction	Wiley		9780471736967	2006	
William Smith and Javad Hashemi	Foundations of Materials Science and Engineering	McGraw Hill		9780073529240	2010	