

**1. General information****Course:** MATERIALS SCIENCE**Type:** CORE COURSE**Degree:** 403 - UNDERGRADUATE DEGREE PROGRAMME IN AEROSPACE ENGINEERING**Center:** 303 - E.DE INGENIERÍA INDUSTRIAL Y AEROESPACIAL DE TOLEDO**Year:** 2**Main language:** Spanish**Use of additional languages:****Web site:** campusvirtual.uclm.es**Code:** 56714**ECTS credits:** 6**Academic year:** 2023-24**Group(s):** 40**Duration:** First semester**Second language:****English Friendly:** N**Bilingual:** N**Lecturer:** ANA ROMERO GUTIERREZ - **Group(s):** 40

Building/Office	Department	Phone number	Email	Office hours
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2. Pre-Requisites

For Materials Science, the student is expected to have knowledge of mathematics, physics and chemistry acquired in the previous course.

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

The contents of the Materials Science subject are directly related to Materials Engineering and Technology and Aerospace Structural Materials, both subjects also compulsory in the degree.

Materials Science provides knowledge of the structure of materials and their properties, as well as their interrelation, basic concepts that must be addressed in order to understand and learn about materials technology and engineering.

4. Degree competences achieved in this course**Course competences**

Code	Description
CA01	Ability to carry out bibliographic searches, use databases and other sources of information for its application in tasks related to Technical Aeronautical Engineering.
CA02	Ability to efficiently design experimentation procedures, interpret the data obtained and specify valid conclusions in the field of Aeronautical Technical Engineering.
CA03	Ability to autonomously select and carry out the appropriate experimental procedure, operating the equipment correctly, in the analysis of phenomena within the scope of Engineering.
CA04	Ability to select advanced tools and techniques and their application in the field of Aeronautical Technical Engineering.
CA05	Knowledge of the methods, techniques and tools as well as their limitations in the application for the resolution of problems typical of Aeronautical Technical Engineering.
CA06	Ability to identify and assess the effects of any solution in the field of Aeronautical Technical Engineering within a broad and global context and the ability to interrelate the solution to an engineering problem with other variables beyond the technological field, which must be considered.
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
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.
CE04	Ability to understand and apply the principles of basic knowledge of general chemistry, organic and inorganic chemistry and their applications in engineering.
CE11	Knowledge of the technological benefits, the optimization techniques of the materials and the modification of their properties by means of treatments.
CE18	Knowledge applied to Engineering of: The fundamentals of fluid mechanics; the basic principles of flight control and automation; the main characteristics and physical and mechanical properties of materials.
CT01	Knowledge of technical vocabulary of subjects related to aerospace engineering, in a second foreign language.
CT03	Correct use of oral and written communication.
CT04	Knowledge of ethical commitment and professional ethics.
CT05	Knowledge of the principles of management skills and teamwork.

5. Objectives or Learning Outcomes**Course learning outcomes**

Description

6. Units / Contents

Unit 1: INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

Unit 2: CRYSTAL STRUCTURE, IMPERFECTIONS AND ATOMIC DIFFUSION

Unit 3: MICROSTRUCTURE AND PHASE TRANSFORMATIONS

Unit 4: MECHANICAL PROPERTIES

Unit 5: PHYSICAL PROPERTIES

Unit 6: MATERIALS FOR AEROSPACE ENGINEERING

ADDITIONAL COMMENTS, REMARKS

During the course, laboratory practices are carried out that will be structured in two blocks:

1.- Metallographic preparation and observation of microstructures.

2.- Mechanical properties.

The schedule and the groups will be published at the beginning of the course on the virtual campus platform.

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	CA01 CA04 CA05 CA06 CE04 CE11 CE18 CT01 CT04	1	25	N		Development in the classroom of the theoretical contents, using the method of the participatory lecture.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	CA02 CA03 CB03 CT05	0.32	8	Y	Y	Laboratory practices where the student puts into practice the knowledge acquired in the theoretical classes through experimentation. Attendance to laboratory practices is considered mandatory for students who opt for continuous assessment. If the student does not carry out the laboratory practices during the course, she must take a theoretical-practical exam that allows evaluating the same contents and skills that are acquired after completing the practices.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CA04 CA05 CA06 CB02 CE04	0.8	20	Y	N	Resolution of exercises and problems in the classroom in a participatory manner. The frequency, interest and quality of the interventions will be assessed by rounding the final grade obtained up to a maximum of 0.25 points. Some of the hours will be taught in a tutored manner and the individual doubts raised by the students will be addressed.
Individual tutoring sessions [ON-SITE]	Guided or supervised work	CB02 CT03	0.12	3	N		Tutorials in which students can consult all doubts regarding the subject. These can be carried out in the classroom.
On-line Activities [OFF-SITE]	Problem solving and exercises	CA01 CA05 CB02 CB03 CE04 CE18 CT03 CT04	0.4	10	Y	Y	Follow-up tests will be carried out on students that will consist of solving problems and/or questions, related to both the theoretical and practical part of the subject. The objective is to promote the work and continuous study of the subject. The delivery of all cases raised on date and form is considered mandatory for students who opt for continuous assessment. If the student does not take the proposed tests during the course or any of them, they must take an exam in this part that evaluates the same contents and skills that are acquired in carrying out these practical cases.
Writing of reports or projects [OFF-SITE]	Combination of methods	CA01 CA02 CA05 CB02 CB03 CE04 CE18 CT03 CT05	0.4	10	Y	N	Based on the work begun in the practical laboratory classes, students must prepare, individually, a report (practice report) where they analyze and capture the results and conclusions of their experience in the laboratory. The delivery of practice reports is considered mandatory for

							students who opt for continuous assessment.
Study and Exam Preparation [OFF-SITE]	Self-study	CA05 CA06 CB02 CB03 CE04 CE11 CT01 CT03	2.8	70	N	-	Autonomous personal study of theory and problems where the student exercises the knowledge learned in the face-to-face classes in the classroom. It also supposes for the student a possibility of self-evaluation facing the progress and final tests.
Final test [ON-SITE]	Assessment tests	CA04 CA05 CB02 CB03 CE04 CE11 CE18 CT03	0.16	4	Y	Y	Written test (final exam) consisting of problems and/or theoretical questions referring to the entire subject. The final test will consist of three parts: final exam of a theoretical/practical nature of the subject, a part corresponding to the laboratory contents and a part referring to the on-line tests. Whoever has passed the laboratory part and the online tests during the course must only answer for the final exam.
Total:			6	150			
Total credits of in-class work: 2.4			Total class time hours: 60				
Total credits of out of class work: 3.6			Total hours of out of class work: 90				

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
Final test	35.00%	70.00%	Test with theoretical and practical aspects of the subject. It is necessary to pass it (4 points out of 10) to compensate or pass this part of the course.
Progress Tests	35.00%	0.00%	An eliminatory progress test of part of the subject of the final test of the ordinary call be taken during the course. The test will consist of a written exam with theoretical and practical contents of the subject. In the case of approving or compensating this part (4 points out of 10).
Laboratory sessions	15.00%	15.00%	Attendance to the practices, the delivery of the report and the completion of the theoretical-practical test referring to the laboratory practices is mandatory to be evaluated with 15% of the final grade in continuous assessment. If the student does not pass this activity, in the final test there will be a block of questions on practices that will have a total weight of 15% and that must be passed (4 points out of 10) to be able to compensate or pass this part of the subject.
Assessment of problem solving and/or case studies	15.00%	15.00%	Practical content test in which problems or cases related to the subject will be raised and which will have a weight of 15% of the total grade. Activity that will be carried out during the course and that will be recoverable by means of an exam that allows the evaluation of similar contents and competences.
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:

Students who have passed the progress test will take an exam with questions related to the syllabus of the remaining subject that will have a weight to be determined, compensating the part already approved. It is necessary to pass the final test with a minimum score of 4 points out of 10 to compensate or pass this part. If the student has not passed the progress test, or this has not been carried out during the course, he must take an exam on all the subject. The weight of this block in the final grade is 70% of the overall grade for the subject.

If the student has not passed the laboratory practices during the course, they must be examined in this part in the final test. It is necessary to pass the practices with a minimum score of 4 points out of 10 to compensate or pass this part. The weight of this block in the final grade is 15% of the overall grade for the subject.

If the student has not taken or passed the tests proposed during the course, they can take an exam in this part that evaluates the same contents and skills that are acquired in carrying out these practical cases and that will have a weight of 15% in the overall grade. of the subject.

To pass the subject it is necessary to get a grade equal to or greater than 5 points out of 10 after taking the weighted average of the 3 parts and meeting the minimum grade criteria indicated.

In the event that the grade of the final test or of the laboratory practices is < 4, the final grade of the subject may not be higher than 4.

Non-continuous evaluation:

The student will be evaluated in a final test that will have a weight of 70% in the overall grade for the subject.

If the student has not done the laboratory practices, they must take a theoretical-practical exam that allows evaluating the skills that are acquired after completing the practices and that will have a weight of 15% in the overall grade for the subject.

If the student has not taken or passed the tests proposed during the course, they can take an exam in this part that evaluates the same contents and skills

that are acquired in carrying out these practical cases and that will have a weight of 15% in the overall grade. of the subject.

In the event that the grade of the final test or of the laboratory practices is < 4, the final grade of the subject may not be higher than 4.

Specifications for the resit/retake exam:

Students who have passed the practicals and problem solving during the course will take an exam with questions related to the syllabus of the subject, whose weight will be 70% of the final grade. It is necessary to pass the exam with a minimum score of 4 out of 10 to compensate or pass this part.

If, on the contrary, the student has not passed or carried out the laboratory practices during the course, they must also be examined in this part in the final test, the weight of this block in the final grade is 15%.

If the student has not passed or carried out the practical cases or proposed tests, they may also take this part in the final test, the weight of this block in the final grade is 15%.

To pass the subject it is necessary to get a grade equal to or greater than 5 points out of 10 after taking the weighted average of the 3 parts and meeting the minimum grade criteria indicated in the ordinary call.

In the event that the grade of the final test or of the laboratory practices is < 4, the final grade of the subject may not be higher than 4.

Specifications for the second resit / retake exam:

The special call for completion will consist of a single exam that may include theoretical or practical questions, problem solving or discussion of practical cases.

To pass the subject it is necessary to get a grade equal to or greater than 5 points out of 10.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	3
Final test [PRESENCIAL][Assessment tests]	4
General comments about the planning: This temporal distribution is indicative and may be modified if the particular circumstances, arising during the development of the course, so advise. The contents, methodology and evaluation systems of the subject may be modified, with the authorization of the Office of the Vice President for Teaching, in situations of alarm due to COVID-19. In any case, the acquisition of the competences of the subject will be ensured.	
Unit 1 (de 6): INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 2 (de 6): CRYSTAL STRUCTURE, IMPERFECTIONS AND ATOMIC DIFFUSION	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
On-line Activities [AUTÓNOMA][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Unit 3 (de 6): MICROSTRUCTURE AND PHASE TRANSFORMATIONS	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
On-line Activities [AUTÓNOMA][Problem solving and exercises]	2
Writing of reports or projects [AUTÓNOMA][Combination of methods]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	14
Unit 4 (de 6): MECHANICAL PROPERTIES	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
On-line Activities [AUTÓNOMA][Problem solving and exercises]	3
Writing of reports or projects [AUTÓNOMA][Combination of methods]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	21
Unit 5 (de 6): PHYSICAL PROPERTIES	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	5
Unit 6 (de 6): MATERIALS FOR AEROSPACE ENGINEERING	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	9
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
On-line Activities [AUTÓNOMA][Problem solving and exercises]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	23
Global activity	
Activities	hours
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	20
Writing of reports or projects [AUTÓNOMA][Combination of methods]	10
Final test [PRESENCIAL][Assessment tests]	4
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	70
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	8
Class Attendance (theory) [PRESENCIAL][Lectures]	25
On-line Activities [AUTÓNOMA][Problem solving and exercises]	10
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Smith, William F.	Fundamentos de la ciencia e ingeniería de materiales	McGraw-Hill		970-10-5638-8	2014	
Massachusetts Institute of Technology	MIT OpenCourseWare https://ocw.mit.edu/courses/materials-science-and-engineering/				2022	
Askeland, Donald R.	Ciencia e ingeniería de los materiales - 6ª Edición	Paraninfo		84-9732-016-6 2001	2014	
Callister, William D., (jr.)	Fundamentals of materials science and engineering : an integrated approach	John Wiley & Sons		978-0-470- 23463-1	2011	
Smith, William F.	Fundamentos de la ciencia e ingeniería de materiales	McGraw-Hill		0-07-296304-2 (CD)	2014	
Universidad de Liverpool	Programa MATTER, Materials Teaching Educational Resources http://www.matter.org.uk/default.htm				2022	
Callister, William D., (jr.)	Introducción a la ciencia e ingeniería de los materiales	Reverté		978-84-291- 7252-2	2009	
Askeland, Donald R.	Título Libro/Revista Población Editorial ISBN Año Descripción Enlace Web Catálogo biblioteca Askeland, Donald R. The science and engineering of materials	Thomson		0-495-24442-2 2006	2010	
Juan Manuel Montes Martos, Francisco Gómez Cuevas y Jesús Cintas Físico	Ciencia e ingeniería de los materiales	Paraninfo		979-84-283- 3017-6	2014	
Ana Romero, G.P. Rodríguez	Ciencia de los materiales				2022	Presentaciones y material de apoyo de la asignatura
Shackelford, James F.	Introducción a la ciencia de materiales para ingenieros	Pearson Prentice Hall		978-84-8322- 659-9	2010	
Smith, William F.	Foundations of materials science and engineering	McGraw-Hill		0-07-296304-2	2014	