UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	MATERIALS ENGINEERING AND TECHNOLOGY	**Code:**	56324
Type:	CORE COURSE	**ECTS credits:**	6
Degree:	351 - UNDERGRADUATE DEGREE PROG. IN MECHANICAL ENGINEERING	**Academic year:**	2019-20
Center:	106 - SCHOOL OF MINING AND INDUSTRIAL ENGINEERING	**Group(s):**	56
Year:	3	**Duration:**	C2
Main language:	Spanish	**Second language:**	English
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **Mª TERESA CUBERES MONTSERRAT** - Group(s): **56**

Building/Office	Department	Phone number	Email	Office hours
2.04, Edificio Elhuyar	MECÁNICA ADA. E ING. PROYECTOS	926052849	teresa.cuberes@uclm.es	Se publicará en el tablón de anuncios del Centro a principio de curso.

2. Pre-Requisites

It is expected that the student will have knowledge of mathematics, physics and chemistry from previous courses, knowledge of Materials Science and basic knowledge of manufacturing.

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

Materials Engineering and Technology is a compulsory subject, taught in the sixth semester, common to the industrial branch. The engineer must know the principles of materials engineering and technology for his/her professional development.

The subject of Materials Engineering and Technology is directly linked to the subject of Materials Science, taught in the third semester, and complements other subjects such as Manufacturing and Design Technology, Calculation and Testing of Machines, etc.

4. Degree competences achieved in this course

Course competences

Code	Description
A01	To understand and have knowledge in an area of study that moves on from the general education attained at secondary level and usually found at a level that, while supported in advanced text books, also includes some aspects that include knowledge found at the cutting edge of the field of study.
A02	To know how to apply knowledge to work or vocation in a professional manner and possess the competences that are usually demonstrated by the formulation and defence of arguments and the resolution of problems in the field of study.
A03	To have the capability to gather and interpret relevant data (normally within the area of study) to make judgements that include a reflection on themes of a social, scientific or ethical nature.
A04	To be able to transmit information, ideas, problems and solutions to a specialized audience.
A05	To have developed the learning skills necessary to undertake subsequent studies with a greater degree of autonomy.
A06	Command of a second foreign language at B1 level of the Common European Framework of Refence for Languages.
A08	Appropriate level of oral and written communication.
A12	Knowledge of basic materials and technologies that assist the learning of new methods and theories and enable versatility to adapt to new situations.
A13	Ability to take the initiative to solve problems, take decisions, creativity, critical reasoning and ability to communicate and transmit knowledge, skills and abilities in Mechanical Engineering.
A14	Knowledge to undertake measurements, calculations, evaluations, appraisals, studies, give expert opinions, reports, work plans and similar tasks.
A15	Ability to work to specifications and comply with obligatory rules and regulations.
C03	Knowledge of the fundamentals of science, technology and chemistry of materials. Understanding of the relation between the microstructure, synthesis, processing and properties of materials.
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
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.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
D07	Knowledge and ability in the application of materials engineering.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

The students will be able to select the most suitable material for an application in simple cases

The students will be able to identify the basic procedures for the improvement of materials through surface engineering

The students will be able to identify the techniques for joining parts by welding and adhesives

The students will be able to identify the most common procedures for material processing techniques and recognize the effects of processing on the structure and properties of the material

The students will be able to distinguish the different heat treatments of metals

The students will get introduced to the engineering and technology of materials

The students will become aware of the importance of knowing and predicting the behaviour of a material when in service

The students will be able to identify the different procedures for part inspection and flaw detection via non-destructive testing

6. Units / Contents

Unit 1: Materials In-service Performance

- **Unit 1.1** Introduction. Objectives of Materials Engineering and Technology.
- **Unit 1.2** Fracture Processes. Fatigue Fracture.
- **Unit 1.3** High Temperature Creep.
- **Unit 1.4** Oxidation and Corrosion.
- **Unit 1.5** Friction, Wear and Lubrication.
- **Unit 1.6** Crack Detection. Non-destructive Testing.

Unit 2: Processing and Forming

- **Unit 2.1** Foundry Processes.
- **Unit 2.2** Plastic Deformation Forming.
- **Unit 2.3** Sintering.
- **Unit 2.4** Processing composite materials.

Unit 3: Thermal Treatments, Joining and Surface Modification.

- **Unit 3.1** Thermal Treatments. TTT Diagrams.
- **Unit 3.2** Quenching and Tempering of Steels.
- **Unit 3.3** Influence of Alloying Elements on the Heat Treatment of Steels.
- **Unit 3.4** Precipitation and Aging Treatment in Aluminium Alloys
- **Unit 3.5** Fundamentals of Welding. Adhesive Bonding.
- **Unit 3.6** Surface Treatments and Coatings against Corrosion.
- **Unit 3.7** Surface Hardening Methods for Wear Resistance.

Unit 4: Materials Selection in Mechanical Engineering.

- **Unit 4.1** Methodology and Resources for the Selection of Materials and Processes.
- **Unit 4.2** Materials Selection: Case-studies (I).
- **Unit 4.3** Materials Selection: Case-studies (II).

ADDITIONAL COMMENTS, REMARKS

Laboratory Practicals

1. Fracture observation.

2. Roughness measurement with an Atomic Force Microscope.

3. Non-destructive Testing: Liquid Penetrate Inspection.

4.Characterization of Foundries.

5. Thermal Treatments: Annealing, Normalising, Quenching and Tempering.

6. Jominy End-Quench Test.

7. Precipitation and Aging Treatment in Al-Co alloys.

8. Electrodeposition. Characterization of coatings.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	R	Description
Class Attendance (theory) [ON-SITE]	Lectures	A01 A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	0.8	20	N	-	-	The Professor will focus the topic and explain the fundamental contents, using blackboard, audiovisual media and chair experiences.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	A01 A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	0.32	8	Y	Y	Y	Development of Laboratory Practicals in small groups.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	A01 A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	0.8	20	Y	N	Y	Lists of problems -provided to the students in advanced - will be discussed and resolved in the classroom (collective learning). Case studies, or work of further developing concepts, may also be included.

Individual tutoring sessions [ON-SITE]	Problem solving and exercises	A01 A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	0.32	8	N	-	-	The professor will individually attend to the students, to solve their doubts in exercises, problems or concepts, and monitor their progress.
Final test [ON-SITE]	Assessment tests	A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	0.16	4	Y	Y	Y	The student will take a final exam of the subject that will consist in short-answer questions and application problems.
Study and Exam Preparation [OFF-SITE]	Self-study	A01 A02 A03 A04 A05 A06 A08 A12 A13 A14 A15 C03 CB01 CB02 CB03 CB04 CB05 D07	3.6	90	N	-	-	The student will revise and study his/her classroom notes, completing them with the bibliography provided by the Professor. Also, he/she will work on the resolution of the lists of problems and case studies that will be discussed in the classroom.
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
R: Rescheduling training activity

8. Evaluation criteria and Grading System

	Grading System		
Evaluation System	**Face-to-Face**	**Self-Study Student**	**Description**
Assessment of active participation	30.00%	30.00%	Participation in Laboratory Practicals, problem solving, case studies, and reports on further developing concepts will be considered for the grading. The actitude and involvement of the student on subject-related activities will also be taken into account.
Final test	70.00%	70.00%	The final test will be passed with a rating of 5/10. It will be necessary to achive independently a 5/10 rating in both problem solving and conceptual issues.
Total:	**100.00%**	**100.00%**	

Evaluation criteria for the final exam:

The evaluation will take into account the participation in Laboratory Practicals, problem solving, case studies, reports on further developing concepts (30%), and the final test (70%). The assistance to the Laboratory Practicals will be a requirement to pass the subject.

Specifications for the resit/retake exam:

The evaluation will be based on the resit/retake exam. The assistance to the Laboratory Practicals will be a requirement to pass the subject.

Specifications for the second resit / retake exam:

The evaluation will be based on the second resit/retake exam. The assistance to the Laboratory Practicals will be a requirement to pass the subject.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

Unit 1 (de 4): Materials In-service Performance

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	22.5

Group 56:

Initial date: 28-01-2020 **End date:** 24-02-2020

Unit 2 (de 4): Processing and Forming

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	4
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	22

Group 56:

Initial date: 24-02-2020 **End date:** 16-03-2020

Unit 3 (de 4): Thermal Treatments, Joining and Surface Modification.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4

Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	26
Group 56:	
Initial date: 16-03-2020	**End date:** 20-04-2020

Unit 4 (de 4): Materials Selection in Mechanical Engineering.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Final test [PRESENCIAL][Assessment tests]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	19.5
Group 56:	
Initial date: 20-04-2020	**End date:** 15-05-2020

Global activity	
Activities	**hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	20
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	8
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	20
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	8
Final test [PRESENCIAL][Assessment tests]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
José Antonio Puértolas Ráfales, Ricardo Ríos Jordana, Miguel Castro Corella, José Manuel Casals Bustos (eds.)	Tecnología de materiales	Síntesis		978-84-907761-1-7	2009	
M. K. Groover	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems (5th Edition)	Wiley		9781118231463	2012	
José Antonio Puértolas Ráfales, Ricardo Ríos Jordana, Miguel Castro Corella	Tecnología de los materiales en ingeniería (Vol 1 y 2).	Síntesis		978849077405-2	2016	
A. W. Batchelor, L. N. Lam, y M. Chandrasekaran	Materials degradation and its control by surface engineering.	Imperial College Press	London	13 978-1-84816-501-4	2011	
APRAIZ BARREIRO	Tratamientos térmicos de los aceros	DOSSAT	Madrid	84-237-0568-4	1984	
Callister, William D.; Rethwisch, David G.	Ciencia e Ingeniería de Materiales 2ed	Reverté		9788429172515	2016	
Carlos Ferrer Giménez y Vicente Amigó Borrás	Tecnología de Materiales	Universidad Politécnica de Valencia	Valencia	84-9705-363-X		
K. G. Budinski, M. K. Budinski	Engineering Materials, Properties and Selection.	Ed. Prentice Hall		9780137128426	2009	
	http://www.pearsonhighered.com/educator/product/Engineering-Materials-Properties-and-Selection/9780137128426.page					
M. Ashby, H. Sherdiff, y D. Cebon	Materials engineering science, processing and design	Butterworth-Heinemann	Oxford	ISBN-13: 978-0-7506-	2007	
M. F. Ashby	Materials selection in mechanical design	Butterworth-Heinemann	Oxford	0-7506-6168-2	2005	
M. K. Groover	Fundamentos de manufactura moderna	Prentice Hall	Mexico	968-880-846-6	1997	
PUÉRTOLAS RÁFALES, RIOS JORDANA, CASTRO CORELLA, CASALS BUSTOS (Editores)	Tecnologías de superficies en materiales	Síntesis	Madrid	: 978-84-975668-0-3	2010	
	http://www.sintesis.com/data/indices/9788497566803.pdf					
S. Kalpakjian y S. R. Schmid	Manufactura, Ingeniería y Tecnología	Pearson Education	Mexico	970-26-0137-1	2002	