UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: METALLURGY
Code: 19568
Type: ELECTIVE
ECTS credits: 6
Degree: 384 - MINING AND ENERGY ENGINEERING DEGREE
Academic year: 2020-21
Center: 106 - SCHOOL OF MINING AND INDUSTRIAL ENGINEERING
Group(s): 51
Year: 4
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **Mª TERESA CUBERES MONTSERRAT** - Group(s): **51**

Building/Office	Department	Phone number	Email	Office hours
2.04, Edificio Elhuyar	MECÁNICA ADA. E ING. PROYECTOS	926052849	teresa.cuberes@uclm.es	To be published at the beginning of the academic term.

2. Pre-Requisites

The students should have knowledge and skills in mathematics, physics, chemistry, fundamentals of mechanics and thermodynamics, materials science and engineering, and resistance of materials from previous courses.

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

The subject of Metallurgy is taught in the seventh semester, included among the specific training subjects in Mining Technology (mention in Mining Technology).

In Metallurgy subject, the student will learn about the processes involved in the transformation of metals, including processing and treatments to improve their properties.

4. Degree competences achieved in this course

Course competences

Code	Description
A11	To understand the multiple legal and technical restrictions which are to be considered in the Mining Engineering field and which are intended, according to what it was established in part 5 of the ministerial order CIN/306/2009 of 09-02-2009, the prospection and mining-geological research, all kind of geological exploitations including ground water, underground works, underground storage, treatment and processing plants , energy plants, metallurgical as well as iron and steel plants, building material plants, carbon and chemical, petrochemical, gas, waste treatment plants and effluents, explosive factories, and capacity to use verified methods and recognized technologies with the aim of getting the highest efficacy having environmental concern and protecting the health and security of workers and users of those facilities.
A12	Capacity to design,, write and plan specific or partial projects of defined units shown in the previous section, such as mechanical and electrical installations and their maintenance, transport of energy networks, transport installations and storage of solid, liquid and gaseous materials, dumps, dams, foundations and upholding level, demolition, restoration, blasts, and explosive logistics.
A13	Capacity to design, plan, operate, inspect, sign and manage projects, plants or installations in their field.
A14	Capacity to carry out studies on urban planning and zoning and environmental aspects related to the projects, plants and installations in their field.
A15	Capacity for the maintenance, preservation and exploitation of the projects, plants and installations in their field,
A16	To carry out in the mining engineering field, according to the acquired knowledge established in section 5 of order CIN/306/2009 (9-02-2009), measurements, layout plans , maps and plans, calculations, assessment, risk analysis, experts¿ reports, studies and reports, work plans, environmental and social studies, restoration plans, quality control systems, prevention systems, analysis and assessment of metallic , ceramic, refractory, synthetic and other materials and properties, ground characterization and rocky mountain ranges and similar works.
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
CT00	To promote respect and promotion of Human Rights as well as global access principles and design for everybody according to the 10th final order of the Law 51/2003 of December 2nd¿ about equal opportunities, non-discrimination and universal accessibility for people with disabilities.
CT01	To master a foreign language, B1 level following the Common European Framework of Reference for Languages.
CT02	To be acquainted with Information and Communication Technology ICT
CT03	Capacity for written and oral communication skills.
CT04	Capacity to accept ethical and deontological professional responsibility.
E13	Capacity to know, understand and use the principles of metalurgy in physics.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

The students will be able to identify the most important non-ferrous alloys and their properties: copper alloys, aluminium alloys, titanium alloys, etc

The students will be able to identify common tools and tests in the field of physical metallurgy

The students will be able to identify the ferrous alloys and their properties: steels and castings, effect of alloying elements, stainless steels, iron based superalloys

The students will be able to identify the processes of casting, forming by plastic deformation, and powder metallurgy of metals and alloys

The students will be able to identify the processes of heat treatment, joining, and surface modification of metals and metal alloys

6. Units / Contents

Unit 1: Introduction to Metallurgy.

- **Unit 1.1** Extractive, Physical, Chemical, Mechanical and Adaptative Metallurgy.
- **Unit 1.2** Fundamentals of Extractive Metallurgy. Metallurgical Processes.
- **Unit 1.3** Siderurgy.

Unit 2: Forming and Joining of Metals.

- **Unit 2.1** Foundry Processes.
- **Unit 2.2** Plastic Deformation Forming. Powder Metallurgy.
- **Unit 2.3** Fundamentals of Welding. Adhesive Bonding.
- **Unit 2.4** In-service Quality and Performance Control Tests.

Unit 3: Metallurgy of Ferrous Materials.

- **Unit 3.1** Steels and Cast Irons. Alloy Steels.
- **Unit 3.2** Heat Treatments of Steels. TTT Diagrams.
- **Unit 3.3** Hardening and Tempering Treatments of Steels.
- **Unit 3.4** Low-alloy Steels.
- **Unit 3.5** Stainless Steels.
- **Unit 3.6** Tool Steels. High-speed Steels.
- **Unit 3.7** Iron-based Superalloys.
- **Unit 3.8** Surface Hardening. Carburizing. Nitriding.
- **Unit 3.9** Corrosion Treatments. Coatings.

Unit 4: Metallurgy of Non-ferrous Materials.

- **Unit 4.1** Copper and Copper Alloys.
- **Unit 4.2** Aluminium and Aluminium Alloys.
- **Unit 4.3** Titanium and Titanium Alloys.
- **Unit 4.4** Cobal- and Nickel-based Superalloys.

ADDITIONAL COMMENTS, REMARKS

Laboratory Practicals

1. Nondestructive Testing. Liquid Penetrant Testing.

2. Characterization of Steels and Foundries.

3. Heat Treatments of Steels I: Annealing and Normalising.

4. Heat Treatments of Steels II: Quenching and Tempering.

5. The Jominy End Quench Test.

6. Electrodeposition. Characterization of Coatings.

7. Characterization of Copper Alloys.

8. Precipitation Hardenning in Aluminium-Copper Alloys.

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	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	0.8	20	N	-	The Professor will focus the topic and explain the fundamentals, using blackboard, audiovisual media and chair experiences.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	0.32	8	Y	Y	Development of Laboratory Practicals in small groups.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	0.8	20	Y	N	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	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	0.32	8	N	-	The professor will individually attend to the students, solve their doubts in exercises, problems or concepts, and monitor their progress.
Final test [ON-SITE]	Assessment tests	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	0.16	4	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	A11 A12 A13 A14 A15 A16 CB01 CB02 CB03 CB04 CB05 CT00 CT01 CT02 CT03 CT04 E13	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 (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
Practicum and practical activities reports assessment	20.00%	20.00%	The Laboratory Praticals reports will be assessed, taking into account the theoretical and procedure explanations, the treatment of the data obtained in the laboratory, the elaboration of graphs and figures, and the presentation of the results.
Assessment of problem solving and/or case studies	5.00%	5.00%	The presentation of the provided lists of problems solved in full detail will be assessed.
Assessment of active participation	5.00%	0.00%	The participation, actitude and involvement of the student on the subject-related activities will be taken into account.
Final test	70.00%	75.00%	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%**	

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 evaluation will take into account the participation in laboratory practicals (20%), problem solving and case studies (5%), the actitude and involvement of the students in the subject-related activities (5%), and the final test (70%). The assistance to the Laboratory Practicals will be a requirement to pass the subject.

Non-continuous evaluation:

The evaluation will take into account the presented reports relative to the Laboratory Practicals (20%), solved lists of problems (5%) and the final test (75%).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**
Final test [PRESENCIAL][Assessment tests]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	12

Unit 1 (de 4): Introduction to Metallurgy.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Group 51:	
Initial date: 07-09-2020	**End date:** 18-09-2020
Group 56:	
Initial date: 07-09-2020	**End date:** 18-09-2020

Unit 2 (de 4): Forming and Joining of Metals.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4

Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	15.5
Group 51:	
Initial date: 21-09-2020	**End date:** 05-10-2020
Group 56:	
Initial date: 21-09-2019	**End date:** 05-10-2019
Unit 3 (de 4): Metallurgy of Ferrous Materials.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	9
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	14
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	43.5
Group 51:	
Initial date: 05-10-2020	**End date:** 27-11-2020
Group 56:	
Initial date: 05-10-2020	**End date:** 27-11-2020
Unit 4 (de 4): Metallurgy of Non-ferrous Materials.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	17
Group 51:	
Initial date: 30-11-2019	**End date:** 08-01-2021
Group 56:	
Initial date: 30-11-2020	**End date:** 8-01-2021
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]	100
Total horas:	160

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Víctor M. Blázquez Martínez, Vicente Lorenzo Esteban, and Benito del Río López	Ingeniería y ciencia de los materiales metálicos	Dextra Editorial			2014	
APRAIZ BARREIRO	Tratamientos térmicos de los aceros	DOSSAT	Madrid	84-237-0568-4	1984	
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					
Fathi Habashi	Handbook of extractive metallurgy (4 Volumes)	Willey - VCH		3-527-28792-2	1997	
G. E. Totten	Steel Heat Treatment Handbook (2nd Edition)	CRC Press		978-0-8493-8455-4	2007	
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	
F. R. Morral, E. Jiménez, P. Molera	Metalurgia general, Tomo 2	Reverté		978-8429160734	2009	
F. R. Morral, E. Jiménez, P. Molera	Metalurgia general, Tomo 1	Reverté		978-8429160727	2009	
Daniel A. Brant, Jarious C. Warner	Metallurgy Fundamentals	The Goodheart-Willcox Company Inc.		1-59070-345-6	2005	
R. E. Smallman, R. J. Bishop	Modern Physical Metallurgy and Materials Engineering (6th Edition)	Butterworth-Heinemann		0 7506 4564 4	1999	
José Antonio Puértolas Ráfales, Ricardo Ríos Jordana, Miguel Castro Corella	Tecnología de los materiales en ingeniería Vol 1.	Síntesis		9788490779293	2016	