ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

43000611 - DiseÑo De Aleaciones Y Metalurgia FÍsica Avanzada

DEGREE PROGRAMME

04AN - Master Universitario En Ingenieria De Materiales

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	43000611 - Diseño de Aleaciones y Metalurgia Física Avanzada
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	04AN - Master Universitario en Ingenieria de Materiales
Centre	04 - Escuela Tecnica Superior De Ingenieros De Caminos, Canales Y Puertos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Nuria Martin Piris	LEM-ETSIAE	nuria.mpiris@upm.es	Sin horario. Under student request by email
Ignacio Luque Trujillo	LEM	ignacio.luque@upm.es	Sin horario. under students request by email

Daniel Barba Cancho (Subject coordinator)	B216/LEM	daniel.barba@upm.es	Sin horario. under student request by e-mail
Conrado Luis Garrido Fernandez De Vera	LEM	conrado.garrido@upm.es	Sin horario. Under student request by email
Sergio Perosanz Amarillo	B216	sergio.perosanz@upm.es	Sin horario. Under student request by email

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Properties Of Materials

3.2. Other recommended learning outcomes

- Metal alloys

- Materials selection

- Materials Science

- Mechanical and chemical behavior

- Non metal materials

4. Skills and learning outcomes *

4.1. Skills to be learned

CE1 - Capacidad para aplicar los fundamentos científicos del comportamiento físico y químico de los materiales para relacionar causalmente sus propiedades fundamentales físicas y químicas con su comportamiento macroscópico y el de los productos con ellos realizados / Ability to apply the scientific foundations of the physical and chemical behavior of materials to correlate their fundamental physical and chemical properties with their macroscopic behavior and that of the products made with them.

CE2 - Uso de equipos y técnicas experimentales de caracterización de materiales (micro y macroestructura, comportamientos mecánico, eléctrico, y óptico) para identificar y analizar los diversos tipos de materiales / Use of equipment and experimental techniques for the characterization of materials (micro and macrostructure, mechanical, electrical, and optical behavior) to identify and analyze the various types of materials.

CE3 - Capacidad de diseñar, modelizar, evaluar, seleccionar, fabricar y utilizar materiales con propiedades específicas (estructurales y funcionales) para satisfa

CG1 - Uso de la lengua inglesa: Los alumnos son capaces de transmitir conocimientos y expresar ideas y argumentos de manera clara, rigurosa y convincente, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia / Use of the English Language: Students are able to transmit knowledge and express ideas and arguments in a clear, rigorous and convincing manner, both orally and in writing, adapting to the characteristics of the situation and the audience .

CG2 - Liderazgo: Los estudiantes son capaces de dirigir y coordinar personas para que trabajen con entusiasmo en la consecución de objetivos en pro del bien común / Leadership: Students are capable of directing and coordinating people so that they work enthusiastically to achieve objectives for the common good.

CG3 - Trabajo en equipo: Los alumnos desarrollan la capacidad para trabajar en equipo, integrarse y colaborar de forma activa en la consecución de objetivos comunes / Teamwork: Students develop the ability to work as a team, integrate and actively collaborate in achieving common goals.

CG4 - Creatividad: Los alumnos son capaces de resolver de forma nueva, original y aportando valor, situaciones o problemas en el ámbito de la ingeniería de materiales / Creativity: Students are able to solve situations or problems in the field of materials engineering in a new, original way and adding value.

CG8 - Resolución de problemas: Los estudiantes son capaces de reconocer, describir, organizar y analizar los elementos constitutivos de un problema para idear estrategias que permitan obtener, de forma razonada, una solución contrastada y acorde a ciertos criterios preestablecidos / Problem solving: Students are able to recognize, describe, organize and analyze the constitutive elements of a problem to devise strategies that allow obtaining, in a reasoned way, a contrasting solution and according to certain pre-established criteria.

CG9 - Análisis y Síntesis: Los alumnos son capaces de reconocer y describir los elementos constitutivos de una realidad, y de proceder a organizar la información significativa según criterios preestablecidos adecuados a un propósito / Analysis and Synthesis: Students are able to recognize and describe the constituent elements of a reality, and to proceed to organize significant information according to pre-established criteria suitable for a purpose.

4.2. Learning outcomes

RA43 - HC1 - Ability to communicate in technical English reports, projects, problems, methodologies, results, etc. related to research and innovation and development in materials engineering in a clear and fluid way

RA41 - HRP1 - Ability to solve problems that require the design of novel structural or functional materials or devices based on them

RA30 - C2 - Knowledge of the physical-chemical, structural, optical, electrical and magnetic properties of advanced structural and functional materials

RA15 - Know, understand and correlate the behavior of materials under different environments with their structure, properties, processing and applications.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The objective of the subject is that students have an overview about the development process of designing new alloys and understand the most important aspects of the physical metallurgy design process and its implications in the industy and technological development.

5.2. Syllabus

1. Introduction and motivation to physical metallurgy
   1.1. Materials properties as a multiscale problem
   1.2. Important of physical metallurgy for current society
   1.3. The engineering design process of a material and difference to material selection
2. Review of basic concepts in physical metallurgy
   2.1. Crystallography and phase diagrams
   2.2. The alloy design process: relationships between processing, material and properties
3. Physical metallurgy for light alloys
   3.1. Advanced Al alloys
   3.2. Magnesium alloys
   3.3. High-performance Ti alloys
4. Physical metallurgy for high-temperature alloys
   4.1. High temperature steel alloys
   4.2. Superalloys
   4.3. Ti-Aluminides
   4.4. Refractory Metals: W, Re, Mo, Ta, Nb
5. Physical metallurgy of high strength alloys
   5.1. High strength steels
6. Alloy design for advanced manufacturing processes

7. Physical metallurgy in Science & Industry

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Lesson 1.** Duration: 01:50 Lecture			
2	**Lesson1.** Duration: 01:50 Lecture			
3	**Lesson2.** Duration: 01:50 Lecture			
4	**Lesson2.** Duration: 01:50 Lecture			
5	**Lesson3.** Duration: 01:50 Lecture			
6	**Lesson3.** Duration: 01:50 Lecture			
7	**Lesson4.** Duration: 01:50 Lecture			
8	**Lesson4.** Duration: 01:50 Lecture			
9	**Lesson4.** Duration: 01:50 Lecture			
10	**Lesson5.** Duration: 01:50 Lecture	**Components and metarials design lab session** Duration: 02:00 Laboratory assignments		
11	**Lesson6.** Duration: 01:50 Lecture			
12	**Lesson7** Duration: 01:50 Lecture			**Attendance and participation at class (minimum 80%)** Other assessment Continuous assessment Presential Duration: 00:00

13				**Group Presentations** Group presentation Continuous assessment Presential Duration: 01:50
14				**Group Presentations** Group presentation Continuous assessment Presential Duration: 01:50
15				**Group Presentations** Group presentation Continuous assessment Presential Duration: 01:50
16				**Final Exam (Continous Evaluation)** Written test Continuous assessment Presential Duration: 01:50
17				**Written test (final examination)** Written test Final examination Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
12	Attendance and participation at class (minimum 80%)	Other assessment	Face-to-face	00:00	20%	8 / 10	CG1
13	Group Presentations	Group presentation	Face-to-face	01:50	40%	4 / 10	CG1 CG2 CG3 CG8 CG4 CG9 CE2 CE3 CE1
14	Group Presentations	Group presentation	Face-to-face	01:50	%	/ 10	CG1 CG2 CG3 CG8 CG4 CG9 CE2 CE3 CE1
15	Group Presentations	Group presentation	Face-to-face	01:50	%	/ 10	CG2 CG3 CG8 CG4 CG9 CE2 CE3 CE1
16	Final Exam (Continous Evaluation)	Written test	Face-to-face	01:50	40%	4 / 10	CG1 CG8 CG4 CG9 CE2 CE3 CE1

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Written test (final examination)	Written test	Face-to-face	02:00	100%	5 / 10	CG1 CG2 CG3 CG8 CG4 CG9 CE2 CE3 CE1

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Written test (final examination)	Written test	Face-to-face	01:50	100%	5 / 10	CG3 CG8 CG4 CG1 CG2 CG9 CE2 CE3 CE1

7.2. Assessment criteria

The students can choose two ways of evaluation:

1. **Continuous evaluation:** The final grade si composed by:
    - Class and Lab attendance (20% of the grade): it is mandatory (minimum 80% of the lectures + lab class time) and it is 20% of total grade. Attendance to laboratory session is mandatory.
    - Group project (40% of the grade): Students who choose this kind of evaluation have to develop an individual/group work based on a engieneering component to perform a material design analysis project and this work must be presented in class at the end of the subject. A minimum of 4/10 is required to pass this part and be evaluated in the continous evaluation.
    - Exam (40% of the grade): students should take a writting exam of 1h which represent 40% of the final grade. All the knowledge taught in class/slides will be evaluated. A mininum grade of 4/10 is required to pass this part and be evaluated in the continous evaluation
2. **Just final exam:** Those students who did not choose or failed continuous evaluation must take a full exam (1.5-2h) about the content of the subject. This corresponds to the 100% of total grade.

For both kinds of evaluations, students have to achieve at least a final grade of 5.0 points over 10.0 total points.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Moodle	Web resource	Classroom slides and notes
The Superalloys, Roger Reed	Bibliography	
Mechanical Metallurgy, G.E. Dieter	Bibliography	
Fundamental Aspects of Structural Alloy Design, R. Jaffee	Bibliography	

Additive Manufacturing: Alloy design and process innovations	Bibliography	

9. Other information

9.1. Other information about the subject

Objetivos de desarrollo sostenible

La asignatura se relaciona con el ODS7 y ODS9: En la asignatura se analizan los efectos medioambientales del uso de las tecnologías actuales para la propulsión espacial basadas en los materiales disponibles y el desarrollo de nuevos materiales que permitan desarrollar nuevas tecnologías menos contaminantes.

Tribunal de la asignatura

Presidente: Daniel BARBA CANCHO

Vocal: Nuria MARTÍN PIRIS

Secretario: María Esther PALACIOS LORENZO

Suplente: Juan Manuel ANTORANZ PÉREZ