

## [GMH301] FOUNDATIONS OF MATERIALS SCIENCE

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHANICAL ENGINEERING	<b>Subject</b>	MATERIAL ENGINEERING
<b>Semester</b>	1	<b>Course</b>	2
<b>Character</b>	COMPULSORY	<b>Mention / Field of specialisation</b>	
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face
<b>Credits</b>	4,5	<b>Language</b>	EUSKARA/CASTELLANO
		<b>Hours/week</b>	4.28
		<b>Total hours</b>	77.02 class hours + 35.48 non-class hours = <b>112.5 total hours</b>

### 2030 AGENDA GOALS



### PROFESSORS

HURTADO HURTADO, JOSE IGNACIO  
 GARAY ARAICO, AINARA  
 AZPI-IÑURRIETA GALPARSORO, ANE (GOIERRI)

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	(No previous knowledge required)

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GMR205</b> - To know the fundamentals of science, technology and chemistry of materials. Understand the relationship between microstructure, synthesis or processing and material properties			x	4,02
<b>G-RTR1</b> - To develop interdisciplinary projects specific to their specialty and of gradual complexity, - becoming aware of respect for human rights and fundamental rights, and analyzing and assessing the impact of the proposed solutions on the SDGs - to acquire and/or apply basic, advanced and/or avant-garde, demonstrating the ability to work in multidisciplinary teams and/or undertake further studies with a high degree of autonomy		x		0,32
<b>G-RTR2</b> - To express information, ideas and the arguments that support them in an orderly, clear and coherent manner, orally and in writing, based on quality information, self-made or obtained from different sources, using inclusive and non-discriminatory language		x		0,16
<b>Total:</b>				<b>4,5</b>

KC: Knowledge or Content / SK: Skills / AB: Abilities

### ENAAE LEARNING RESULTS

- ENA102** - Knowledge and comprehension: Knowledge and comprehension of the engineering disciplines of their speciality, at the level necessary to acquire the rest of the competencies of the degree, including notions of the latest advances.
- ENA103** - Knowledge and comprehension: Awareness of the multidisciplinary context of engineering.
- ENA104** - Analysis in engineering: The ability to analyse complex products, processes and systems in their field of study; choose and apply relevant analytical, calculation and experimental methods in a suitable way; and correctly interpret the results of such analyses.
- ENA106** - Engineering projects: Ability to project, design and develop complex products (parts, components, finished products, etc.), processes and systems of their speciality, which meet the established requirements, including awareness of the social, health and safety, environmental, economic and industrial aspects, as well as selecting and applying appropriate project methods.
- ENA109** - Research and innovation: Ability to consult and apply codes of good practice and security in their speciality.
- ENA110** - Research and innovation: Capacity and ability to project and carry out experimental investigations, interpret results, and reach conclusions in their field of study.
- ENA111** - Practical application of engineering: Understanding of the applicable techniques and methods for analysis, design and research and their limitations in the field of their speciality.
- ENA113** - Practical application of engineering: Knowledge of application of materials, equipment and tools, engineering technology and processes, and their limitations in the field of their speciality.
- ENA114** - Practical application of engineering: Ability to apply standards of engineering practice in their speciality.
- ENA118** - Preparation of judgements: Ability to manage complex technical or professional activities or projects of their speciality, taking responsibility for decision making.
- ENA119** - Communication and Teamwork: Ability to effectively communicate information, ideas, problems and solutions in the field of engineering and with society in general.
- ENA120** - Communication and Teamwork: Ability to operate effectively in domestic and international contexts, individually and as a team, and to cooperate with both engineers and people from other disciplines.

### SECONDARY LEARNING RESULTS

**1RGM290** (1 sem)

### LEARNING ACTIVITIES

Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams

CH

2 h.

NCH

1 h.

TH

3 h.

### EVALUATION SYSTEM

W

100%

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

### MAKE-UP MECHANISMS

(No mechanisms)

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

CH - Class hours: 2 h.

NCH - Non-class hours: 1 h.

TH - Total hours: 3 h.

## 1RGM293 (1 sem)

### LEARNING ACTIVITIES

Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams

CH

1,34 h.

NCH

,66 h.

TH

2 h.

### EVALUATION SYSTEM

W

100%

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

### MAKE-UP MECHANISMS

(No mechanisms)

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

CH - Class hours: 1,34 h.

NCH - Non-class hours: ,66 h.

TH - Total hours: 2 h.

## 1RGM294 (1 sem)

### LEARNING ACTIVITIES

Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams

CH

1,34 h.

NCH

,66 h.

TH

2 h.

### EVALUATION SYSTEM

W

100%

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

### MAKE-UP MECHANISMS

(No mechanisms)

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

CH - Class hours: 1,34 h.

NCH - Non-class hours: ,66 h.

TH - Total hours: 2 h.

## RGM217 [I] Relaciona las propiedades mecánicas y físicas de los metales con su composición y tratamiento térmico

LEARNING ACTIVITIES		CH	NCH	TH
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning		2 h.	6 h.	8 h.
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams		2 h.	4 h.	6 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects		15 h.	2 h.	17 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	10%	Individual written and/or oral tests or individual coding/programming tests		
Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems	25%			
Individual written and/or oral tests or individual coding/programming tests	65%			
<b>CH - Class hours:</b> 19 h. <b>NCH - Non-class hours:</b> 12 h. <b>TH - Total hours:</b> 31 h.				

1RGM292 (1 sem)				
LEARNING ACTIVITIES		CH	NCH	TH
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams		1,34 h.	,66 h.	2 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems	100%	(No mechanisms)		
Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		
CH - Class hours: 1,34 h.				
NCH - Non-class hours: ,66 h.				
TH - Total hours: 2 h.				

1RGM291 (1 sem)				
LEARNING ACTIVITIES		CH	NCH	TH
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams		2 h.	1 h.	3 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems	100%	(No mechanisms)		
Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		
CH - Class hours: 2 h.				
NCH - Non-class hours: 1 h.				

**TH - Total hours:** 3 h.

**RGM215** [!] *Comprende los fundamentos metalúrgicos de las transformaciones que se dan en los procesos de fabricación de metales en caliente*
**LEARNING ACTIVITIES**

	CH	NCH	TH
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	1 h.	2 h.	3 h.
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	4 h.	2,5 h.	6,5 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	11 h.	1 h.	12 h.

**EVALUATION SYSTEM**
**W**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

10%

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

80%

Individual written and/or oral tests or individual coding/programming tests

**MAKE-UP MECHANISMS**

Individual written and/or oral tests or individual coding/programming tests

**CH - Class hours:** 16 h.

**NCH - Non-class hours:** 5,5 h.

**TH - Total hours:** 21,5 h.

**RGM218** [!] *Relaciona la formación interna de los materiales poliméricos con sus propiedades mecánicas y físicas*
**LEARNING ACTIVITIES**

	CH	NCH	TH
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	8 h.	2 h.	10 h.
Practical work in workshops and/or laboratories, individually and/or in teams	6 h.	2 h.	8 h.

**Comments:** The laboratory activities are carried out with state-of-the-art machines and equipments.

**EVALUATION SYSTEM**
**W**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

25%

Individual written and/or oral tests or individual coding/programming tests

75%

**MAKE-UP MECHANISMS**

Individual written and/or oral tests or individual coding/programming tests

**CH - Class hours:** 14 h.

**NCH - Non-class hours:** 4 h.

**TH - Total hours:** 18 h.

**RGM216** [!] *Relaciona los mecanismos microestructurales con el comportamiento mecánico de los metales*
**LEARNING ACTIVITIES**

	CH	NCH	TH
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	2 h.	3 h.	5 h.
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	2 h.	5 h.	7 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and	16 h.	2 h.	18 h.

procedures associated with the subjects

**EVALUATION SYSTEM**

**w**

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

10%

Individual written and/or oral tests or individual coding/programming tests

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

35%

Individual written and/or oral tests or individual coding/programming tests

55%

**CH - Class hours:** 20 h.

**NCH - Non-class hours:** 10 h.

**TH - Total hours:** 30 h.

## CONTENTS

### FIRST PART

1. Chemistry review (bonding, structures, defects and alloys)
2. Strain
3. Hardening mechanism. Recrystallization
4. Solidification
5. Diffusion
6. Phases diagram

### SECOND PART

1. Fe-C diagram
2. Steels
3. Cast iron
4. Thermal treatment
5. Surface treatments
6. Non ferrous alloys (Al and Cu)
7. Polymers

### THIRD PART (POPBL)

1. Tests
2. Hardness
3. Tensile tests
4. Charpy

## LEARNING RESOURCES AND BIBLIOGRAPHY

### Learning resources

Topic related web quires  
Video projections  
Lab practical training  
Moodle Platform  
Class presentations

### Bibliography

J.F. Shackelford, "Introducción a la Ciencia de Materiales para Ingenieros", 4ª Edición, Ed. Prentice Hall, Madrid, 1998.  
J.M. Sánchez-Marín y J.M. Lasheras, "Conocimiento de Materiales", 8ª Edición, Ed. Donostiarra, 1987.  
J. Apraiz, "Tratamientos térmicos de los aceros", 8ª Edición, Ed. CIE Dossat 2000, 1984.  
W. Michaeli, "Introducción a la tecnología de los plásticos", 1ª Edición, Ed. Hanser, 1992.

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Hellerich, Harsch y Haenle, "Guía de materiales plásticos: propiedades, ensayos, parámetros", 1ª Edición, Ed. Hanser, 1992.  
W.E. Diver, "Química y tecnología de los plásticos", 1ª Edición, Ed. C.E.C.S.A., 1982.  
W.D. Callister, "Ciencia e Ingeniería de Materiales", Vol. II, 3ª Edición, Ed. Reverté, Barcelona, 1995.  
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