

## [GMH302] ENGINEERING MATERIALS

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHANICAL ENGINEERING	<b>Subject</b>	?
<b>Semester</b>	2	<b>Course</b>	3
<b>Character</b>	COMPULSORY	<b>Mention / Field of specialisation</b>	
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face
<b>Credits</b>	6	<b>Hours/week</b>	3.61
		<b>Language</b>	CASTELLANO/EUSKARA
		<b>Total hours</b>	65 class hours + 85 non-class hours = <b>150 total hours</b>

### PROFESSORS

TATO VEGA, GUILSON	
AGINAGALDE LOPEZ, ANDREA	
IBARRETXE LOPEZ, UNAI	

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
FOUNDATIONS OF MATERIALS SCIENCE CHEMISTRY	knowledge on crystalline structure, crystalline defects, hardening mechanisms Oxidation-reduction reactions basics Microstructure-mechanical properties relation

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GMR313</b> - To apply materials engineering knowledge		x		5,08
<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		0,44
<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		0,48
<b>Total:</b>				<b>6</b>

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

#### ENAE 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.
- ENA105** - Analysis in engineering: The ability to identify, formulate and solve engineering problems in their speciality; choose and apply adequately established analytical, calculation and experimental methods; and acknowledge the importance of social, health and safety, environmental, economic, and industrial restrictions.
- 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.
- ENA107** - Engineering projects: Project capacity some state-of-the-art knowledge of their engineering speciality.
- ENA108** - Research and innovation: Ability to carry out bibliographic searches and consult and use databases and other information sources with discretion, in order to carry out simulation and analysis with the aim of conducting research on technical topics of their speciality.
- 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.
- ENA112** - Practical application of engineering: Practical competency to solve complex problems, carry out complex engineering projects, and conduct investigations specific to 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.
- ENA115** - Practical application of engineering: Knowledge of the social, health and safety, environmental, economic and industrial implications of engineering practice.
- 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.

ENA122 - Continued training: Ability to stay up to date on science and technology innovations.

**SECONDARY LEARNING RESULTS**

**RGM390** [!] *Definir y gestionar los objetivos y la planificación de un proyecto que le permita adquirir y/o reforzar los conocimientos de tecnologías específicas de su especialidad,- que en ocasiones llegan a la vanguardia del conocimiento- y definir una estrate*

**LEARNING ACTIVITIES**

*CH NCH TH*

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. 4 h.

**EVALUATION SYSTEM**

*W*

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

**Comments:** Students have the responsibility of meeting the tutor to do the tracking of the project and to ensure the achievement of the goals.

**MAKE-UP MECHANISMS**

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

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

**CH - Class hours:** 0 h.  
**NCH - Non-class hours:** 4 h.  
**TH - Total hours:** 4 h.

**RGM391** [!] *Coordinar el equipo de trabajo, estimulando la cohesión y buen clima para lograr la integración de todas las personas y su contribución para alcanzar un rendimiento apropiado, tanto a nivel individual como grupal, para el desarrollo del proyecto en*

**LEARNING ACTIVITIES**

*CH NCH TH*

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. 4 h.

**EVALUATION SYSTEM**

*W*

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

Self-assessment 50%  
**Comments:** Students have the responsibility of meeting the tutor to do the tracking of the project and to ensure the achievement of the goals. The average of the marks of the tutor's assessment and the self-assessment carried out by the work team is calculated, using the defined rubrics. Afterwards, the final mark is calculated by multiplying that average mark by a factor calculated on the basis of the co-evaluation among the members of the group.

**MAKE-UP MECHANISMS**

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

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

**CH - Class hours:** 0 h.  
**NCH - Non-class hours:** 4 h.  
**TH - Total hours:** 4 h.

**RGM392** [!] *Identificar y argumentar de forma precisa los ODS en los que incide el proyecto realizado, aportando posibles acciones para la mejora.*

**LEARNING ACTIVITIES**

*CH NCH TH*

Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams 3 h. 3 h.

**EVALUATION SYSTEM**

*W*

Reports on the completion of exercises, case studies, 100%

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer

<p>computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems</p> <p><b>Comments:</b> Students have the responsibility of meeting the tutor to do the tracking of the project and to ensure the achievement of the goals.</p> <p><b>CH - Class hours:</b> 0 h. <b>NCH - Non-class hours:</b> 3 h. <b>TH - Total hours:</b> 3 h.</p>	<p>exercises, simulation exercises, laboratory exercises, term projects, challenges and problems</p> <p><b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the semester project follow-up meetings.</p>
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**RGM393** [!] *Elabora la memoria del proyecto, aportando argumentos elaborados y haciendo un uso correcto, inclusivo y no discriminatorio del lenguaje.*

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		6 h.	6 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	100%	Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems
<b>Comments:</b> Students have the responsibility of meeting the tutor to do the tracking of the project and to ensure the achievement of the goals.		<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the semester project follow-up meetings.

**CH - Class hours:** 0 h.  
**NCH - Non-class hours:** 6 h.  
**TH - Total hours:** 6 h.

**RGM394** [!] *Realiza una presentación oral del proyecto, justificando las soluciones propuestas con argumentos elaborados y precisos, y haciendo un uso correcto, inclusivo y no discriminatorio del lenguaje.*

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.	4 h.	6 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%	Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems
<b>Comments:</b> Students have the responsibility of meeting the tutor to do the tracking of the project and to ensure the achievement of the goals.		<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the semester project follow-up meetings.

**CH - Class hours:** 2 h.  
**NCH - Non-class hours:** 4 h.  
**TH - Total hours:** 6 h.

**RGM331** [!] *Relaciona las características de los materiales compuestos con sus propiedades y ámbitos de aplicación, según la composición y el proceso de fabricación*

LEARNING ACTIVITIES	CH	NCH	TH
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Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	5 h.	4 h.	9 h.
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	1 h.		1 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	12 h.	6 h.	18 h.
Carrying out exercises and solving problems individually and/or in teams	1 h.	4 h.	5 h.
Practical work in workshops and/or laboratories, individually and/or in teams	1 h.		1 h.
<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>	
Individual written and/or oral tests or individual coding/programming tests	100%	Individual written and/or oral tests or individual coding/programming tests	
<b>CH - Class hours: 20 h.</b>			
<b>NCH - Non-class hours: 14 h.</b>			
<b>TH - Total hours: 34 h.</b>			

**RGM332** [!] *Comprende los fundamentos de los principales fenómenos de degradación que pueden experimentar los materiales en uso y define las posibles soluciones de diseño, para mejorar su comportamiento en servicio*

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	2 h.	8 h.	10 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	12 h.		12 h.
Carrying out exercises and solving problems individually and/or in teams	2 h.	3 h.	5 h.
<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>	
Individual written and/or oral tests or individual coding/programming tests	100%	Individual written and/or oral tests or individual coding/programming tests	
<b>CH - Class hours: 18 h.</b>			
<b>NCH - Non-class hours: 15 h.</b>			
<b>TH - Total hours: 33 h.</b>			

**RGM333** [!] *Selecciona materiales para el diseño de componentes y productos teniendo en cuenta las especificaciones y el procesado, y utilizando la metodología adecuada*

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	2 h.	4 h.	6 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	3 h.	3 h.	6 h.
Computer simulation exercises, individually and/or in teams	4 h.	5 h.	9 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	10 h.		10 h.
Carrying out exercises and solving problems individually and/or in teams	1 h.	1 h.	2 h.
<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>	
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	Individual written and/or oral tests or individual coding/programming tests	
<b>CH - Class hours: 20 h.</b>			
<b>NCH - Non-class hours: 13 h.</b>			
<b>TH - Total hours: 33 h.</b>			

**RGM334 [!]** *Analiza y dimensiona elementos que trabajan bajo cargas cíclicas*

<b>LEARNING ACTIVITIES</b>		<i>CH</i>	<i>NCH</i>	<i>TH</i>
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams		5 h.	22 h.	27 h.
<b>EVALUATION SYSTEM</b>	<i>W</i>	<b>MAKE-UP MECHANISMS</b>		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	40%	Individual written and/or oral tests or individual coding/programming tests		
Individual written and/or oral tests or individual coding/programming tests	60%			

**CH - Class hours:** 5 h.  
**NCH - Non-class hours:** 22 h.  
**TH - Total hours:** 27 h.

**CONTENTS**

1. Composite Materials
  - 1.1 Raw Materials
  - 1.2 Mechanical Behaviour
  - 1.3 Transformation Processes
  - 1.4 Sustainability and actual challenges
2. Materials Degradation
  - 2.1 Corrosion and Wear
  - 2.2 Coatings
  - 2.3. Fatigue
3. Materials Selection
  - 3.1. Materials selection methodology
  - 3.2. Performance index
  - 3.3. Case study

**LEARNING RESOURCES AND BIBLIOGRAPHY**

<b>Learning resources</b>	<b>Bibliography</b>
Video projections	"Matériaux composites à matrice organique"; G. Chrétien; Technique et Documentation (Lavoisier); Paris, 1986
Slides of the subject	"Matériaux composites à matrice organique"; G. Chrétien; Technique et Documentation (Lavoisier); Paris, 1986
Technical articles	Kendú "Materials Science and Engineering"; W.D. Callister Jr and D.G. Rethwisch; John Wiley and sons; 9th edition; 2011
Presentations by external Lecturers	"Introduction to Materials Science for Engineers"; J.F. Shackelford; Pearson Education Limited; 2016
Class presentations	A practical Guide to Composites. 1995. Multisport Composites Limited, Bolton.
Specific Master Software	Materials selection in mechanical design / Michael F. Ashby. Butterworth-Heinemann. 2017.
Moodle Platform	ASM Metal Handbooks
Topic related web quires	
Labs	

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Ralph I. Stephens; Ali Fatemi; Robert R. Stephens; O. Fuchs, Metal Fatigue in Engineering. John Wiley & Sons, Inc, 2001.  
Jaap Schijve, Fatigue of Structures and Materials. Springer, 2009  
P.G. Forrest, Fatiga de los metales. Ediciones URMO, 1972  
<https://www.grantadesign.com/education/students/>