

## [GME301] MATERIAL ELASTICITY AND STRENGTH I

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHANICAL ENGINEERING	<b>Subject</b>	RESISTANCE OF MATERIALS AND THEORY OF STRUCTURES
<b>Semester</b>	2	<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>Hours/week</b>	3.61
		<b>Language</b>	CASTELLANO/EUSKARA
		<b>Total hours</b>	65 class hours + 47.5 non-class hours = <b>112.5 total hours</b>

### PROFESSORS

IRAGUI SAN PEDRO, MIKEL
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### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
MATHEMATICS I	<i>(No previous knowledge required)</i>
MATHEMATICS II	
MATHEMATICS III	
PHYSICS I	
MECHANICS	
MATERIALS SCIENCE FOUNDATIONS	

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GMR206</b> - To know and use the principles of material resistance		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		0,24
<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		0,24
<b>Total:</b>				4,5

*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.
- 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.
- 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.

### SECONDARY LEARNING RESULTS

**RGM219** [!] *Identifica y evalúa las situaciones tensionales que soportan los elementos estructurales*

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	4 h.	7 h.	11 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	15 h.		15 h.
Carrying out exercises and solving problems individually and/or in teams	4 h.	8 h.	12 h.

**Comments:** Analyses and evaluates structural components, to fulfill working and safety conditions

**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%

**Comments:**  $N1 = 0.75 \cdot KP1 + 0.25 \cdot A1 < 5 \rightarrow$  R1 retake exam must be done

**MAKE-UP MECHANISMS**

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

**Comments:**  $R1 \cdot 0.75 + N1 \cdot 0.25$

**CH - Class hours:** 23 h.

**NCH - Non-class hours:** 15 h.

**TH - Total hours:** 38 h.

**RGM220** [!] *Calcula y dimensiona, mediante criterios de rigidez y resistencia, los elementos estructurales simples sometidos a cargas estáticas, y define su estado de deformación*

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	3 h.	5 h.	8 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	20 h.		20 h.
Carrying out exercises and solving problems individually and/or in teams	5 h.	7,5 h.	12,5 h.

**Comments:** Analyses and evaluates structural components, to fulfill working and safety conditions

**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%

**Comments:**  $N2 = 0,25 \cdot A2 + 0,75 \cdot KP2 \ N2 < 5 \rightarrow$  R2 retake exam must be done

**MAKE-UP MECHANISMS**

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

**Comments:**  $N2 \cdot 0,25 + R2 \cdot 0,75$

**CH - Class hours:** 28 h.

**NCH - Non-class hours:** 12,5 h.

**TH - Total hours:** 40,5 h.

**RGM291** [!] *Establecer las responsabilidades de los miembros del equipo utilizando técnicas adecuadas para fomentar la eficiencia del equipo para el desarrollo del proyecto en los plazos establecidos (compartir recursos, aportar ideas, habilidades comunicativas)*

**LEARNING ACTIVITIES**

	<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	1 h.	2 h.	3 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 Self-assessment <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 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 the average mark by a factor calculated on the basis of the co-evaluation among the members of the group	50%  50%	(No mechanisms) <b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the project follow-up meetings
<b>CH - Class hours:</b> 1 h. <b>NCH - Non-class hours:</b> 2 h. <b>TH - Total hours:</b> 3 h.		

**RGM290** [!] *Proponer los objetivos y la planificación de un proyecto que le permita adquirir y/o reforzar los conocimientos de tecnologías propias de su especialidad,- que en ocasiones llegan a la vanguardia del conocimiento- y definir una estrategia de aprendiz*

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	1 h.	2 h.	3 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 <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	100%	(No mechanisms) <b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the project follow-up meetings
<b>CH - Class hours:</b> 1 h. <b>NCH - Non-class hours:</b> 2 h. <b>TH - Total hours:</b> 3 h.		

**RGM293** [!] *Redacta y estructura correctamente la memoria del proyecto, haciendo un uso correcto, inclusivo y no discriminatorio del lenguaje. Para ello, busca y hace uso de las fuentes de información adecuadas.*

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 h.	2 h.	3 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 <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	100%	(No mechanisms) <b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor in the project follow-up meetings
<b>CH - Class hours:</b> 1 h. <b>NCH - Non-class hours:</b> 2 h. <b>TH - Total hours:</b> 3 h.		

**RGM294** [!] *Realiza una presentación oral del proyecto con argumentos elaborados por sí mismos y haciendo un uso correcto,*

*inclusivo y no discriminatorio del lenguaje.*

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
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 h.	2 h.	3 h.

**EVALUATION SYSTEM**

*W*

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:** 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**

*(No mechanisms)*

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

**CH - Class hours:** 1 h.  
**NCH - Non-class hours:** 2 h.  
**TH - Total hours:** 3 h.

**RGM221 [!]** *Modeliza, calcula y dimensiona elementos estructurales simples atendiendo a las especificaciones definidas en su diseño*

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
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.
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	.5 h.	1 h.	1,5 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	7,5 h.	7 h.	14,5 h.

**Comments:** Analyses and evaluates structural components to fulfill working and safety conditions, considering manufacturing and economic criteria.

**EVALUATION SYSTEM**

*W*

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

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:** The mark of this learning outcome is the technical mark of the semester project. It is based on the report delivered, the achieved results, the abilities shown and the defence

**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

**Comments:** The assessment of the project is continuous, and based on the tracking meetings carried out with the tutor and experts. One week before the final report delivery, a final tracking meeting is done where the work done is presented and the aspects that should be improved are identified.

**CH - Class hours:** 10 h.  
**NCH - Non-class hours:** 12 h.  
**TH - Total hours:** 22 h.

**CONTENTS**

0. Introduction
1. Internal forces, stress resultants and diagrams
2. Stress and strain
3. Axial force. Tension-Compression
4. Torsion

5. Bending

**LEARNING RESOURCES AND BIBLIOGRAPHY**

**Learning resources**

Moodle Platform  
[!]

**Bibliography**

Mechanics of Materials, Roy R. Craig Jr., 3rd edition, 2011, ISBN 978-0-470-48181-3, John Wiley and Sons  
Introduction to Linear Elasticity, Phillip L. Gould, 3rd ed., 2013, ISBN: 978-1-4614-4833-4 (Online), Springer  
Strength and Stiffness of Engineering Systems, Frederick A. Leckie, Dominic J. Dal Bello, 2009, ISBN: 978-0-387-49474-6 (Online), Springer  
Mechanics of Materials, R. C. Hibbeler., 9th edition, 2014, ISBN 978-0-13-325442-6, Pearson  
Mechanics of Materials, F. P. Beer., 6th edition, 2012, ISBN 978-0-07-338028-5, McGrawHill  
Mechanics and Strength of Materials, Vitor Dias da Silva, 2006, ISBN: 978-3-540-30813-3 (Online), Springer