

## [GEJ302] MODELLING, SIMULATION AND CONTROL OF MULTI-PHYSICAL SYSTEMS

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN INDUSTRIAL ELECTRONICS ENGINEERING		<b>Subject</b>	TOOLING, AUTOMATION AND CONTROL
<b>Semester</b>	2	<b>Course</b>	2	<b>Mention / Field of specialisation</b>
<b>Character</b>	COMPULSORY		<b>Language</b>	CASTELLANO/EUSKARA
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face	<b>Total hours</b>
<b>Credits</b>	4,5	<b>Hours/week</b>	4.17	75 class hours + 37.5 non-class hours = <b>112.5 total hours</b>

### PROFESSORS

BADIOLA Aiestaran, Xabier

### REQUIRED PREVIOUS KNOWLEDGE

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

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GER211</b> - To demonstrate knowledge and ability to model and simulate systems		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>				<b>4,5</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.
- 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.
- ENA117** - Preparation of judgements: Ability to collect and interpret data and handle complex concepts within their speciality, in order to make judgements that involve reflection on ethical and social issues.
- 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

**RGE290** [!] *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	2 h.	1 h.	3 h.
<b>EVALUATION SYSTEM</b>	<i>W</i>	<b>MAKE-UP MECHANISMS</b>	
Observation (technical capacity, attitude and participation)	100%	Observation (technical capacity, attitude and participation)	
<b>Comments:</b> Continuous assessment.			
<b>CH - Class hours:</b> 2 h.			
<b>NCH - Non-class hours:</b> 1 h.			
<b>TH - Total hours:</b> 3 h.			

**RGE291** [!] *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)*

<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	2 h.	1 h.	3 h.
<b>EVALUATION SYSTEM</b>	<i>W</i>	<b>MAKE-UP MECHANISMS</b>	
Observation (technical capacity, attitude and participation)	100%	Observation (technical capacity, attitude and participation)	
<b>Comments:</b> Continuous assessment.			
<b>CH - Class hours:</b> 2 h.			
<b>NCH - Non-class hours:</b> 1 h.			
<b>TH - Total hours:</b> 3 h.			

**RGE293** [!] *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.*

<b>LEARNING ACTIVITIES</b>	<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.	1 h.	3 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	100%	Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	
<b>Comments:</b> - Continuous assessment. - It may be asked to redo the document.			
<b>CH - Class hours:</b> 2 h.			
<b>NCH - Non-class hours:</b> 1 h.			
<b>TH - Total hours:</b> 3 h.			

**RGE294** [!] *Realiza una presentación oral del proyecto con argumentos elaborados por sí mismos y haciendo un uso correcto, inclusivo y no discriminatorio del lenguaje.*

<b>LEARNING ACTIVITIES</b>	<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.	1 h.	3 h.
<b>EVALUATION SYSTEM</b>	<i>W</i>	<b>MAKE-UP MECHANISMS</b>	

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%	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 <b>Comments:</b> - Continuous assessment.
<b>CH - Class hours:</b> 2 h. <b>NCH - Non-class hours:</b> 1 h. <b>TH - Total hours:</b> 3 h.		

<b>RGE225</b> [!] <i>Modela el comportamiento dinámico de sistemas multifísicos simples mediante funciones de transferencia</i>			
<b>LEARNING ACTIVITIES</b>			
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	10 h.		10 h.
Carrying out exercises and solving problems individually and/or in teams	21 h.	19 h.	40 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>Comments:</b> - Control point: minimum grade 5.			<b>Comments:</b> - Students with less than a 5 at the control point must retake the exam. - Final note of the control point: control point 25% and retake 75%.
<b>CH - Class hours:</b> 32 h. <b>NCH - Non-class hours:</b> 19 h. <b>TH - Total hours:</b> 51 h.			

<b>RGE226</b> [!] <i>Analiza el problema de simulación y simula sistemas lineales</i>			
<b>LEARNING ACTIVITIES</b>			
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	1 h.		1 h.
Computer simulation exercises, individually and/or in teams	16 h.	10,5 h.	26,5 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>Comments:</b> - Control point: minimum grade 5.			<b>Comments:</b> - Students with less than a 5 at the control point must retake the exam. - Final note of the control point: control point 25% and retake 75%.
<b>CH - Class hours:</b> 17 h. <b>NCH - Non-class hours:</b> 10,5 h. <b>TH - Total hours:</b> 27,5 h.			

<b>RGE227</b> [!] <i>Aplica y ajusta los parámetros de controladores básicos en una aplicación simple de control</i>			
<b>LEARNING ACTIVITIES</b>			
Carrying out work experience in real environments and writing the corresponding report	18 h.	4 h.	22 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 Individual written and/or oral tests or individual coding/programming tests Prototype / Product	20%  50%  30%	Prototype / Product <b>Comments:</b> - In the project / PBL there will not be any retake of the individual defense.
<b>Comments:</b> - PBL project grade: 30% product, 20% technical content of the report and 50% individual technical defense.		
<b>CH - Class hours:</b> 18 h. <b>NCH - Non-class hours:</b> 4 h. <b>TH - Total hours:</b> 22 h.		

## CONTENTS

## LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Moodle Platform	Palm, William. System Dynamics (2. ed). McGraw-Hill. New York. 2010. ISBN: 978-007-126779-3 Borelli, Robert; Courtney, S.Coleman. Ecuaciones diferenciales, una perspectiva de modelación. Oxford University Press. 2002 Woods, Robert L.; Lawrence, Kent L. Modeling and simulation of dynamic systems. Prentice Hall. New Jersey. 1997 Kluever, Craig A. Dynamic Systems: Modeling, Simulation and Control. Wiley. 2015. ISBN: 978-1-118-28945-7