

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

GENERAL INFORMATION

Studies	DEGREE IN INDUSTRIAL ELECTRONICS ENGINEERING		Subject	TOOLING, AUTOMATION AND CONTROL	
Semester	2	Course	2	Mention / Field of specialisation	
Character	COMPULSORY				
Plan	2022	Modality	Face-to-face	Language	EUSKARA/CASTELLANO
Credits	4,5	Hours/week	4.17	Total hours	75.02 class hours + 37.48 non-class hours = 112.5 total hours

2030 AGENDA GOALS



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
GER211 - To demonstrate knowledge and ability to model and simulate systems		x		4,02
G-RTR1 - 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
G-RTR2 - 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
Total:				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 specialty, 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 specialty, 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 specialty.
- 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 specialty.
- ENA112** - Practical application of engineering: Practical competency to solve complex problems, carry out complex engineering projects, and conduct investigations specific to their specialty.
- 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 specialty.
- ENA117** - Preparation of judgements: Ability to collect and interpret data and handle complex concepts within their specialty, 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 specialty, 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

RGE226 [!] *Analiza el problema de simulación y simula sistemas lineales*

LEARNING ACTIVITIES		CH	NCH	TH
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.
EVALUATION SYSTEM		W	MAKE-UP MECHANISMS	
Individual written and/or oral tests or individual coding/programming tests		100%	Individual written and/or oral tests or individual coding/programming tests	
Comments: - Control point: minimum grade 5.			Comments: - 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%.	

CH - Class hours: 17 h.
NCH - Non-class hours: 10,5 h.
TH - Total hours: 27,5 h.

2RGE292 (2 sem)				
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		1,34 h.	,66 h.	2 h.
EVALUATION SYSTEM		W	MAKE-UP MECHANISMS	
Observation (technical capacity, attitude and participation)		100%	Observation (technical capacity, attitude and participation)	
			Comments: Continuous assessment.	

CH - Class hours: 1,34 h.
NCH - Non-class hours: ,66 h.
TH - Total hours: 2 h.

RGE225 [!] <i>Modela el comportamiento dinámico de sistemas multifísicos simples mediante funciones de transferencia</i>				
LEARNING ACTIVITIES		CH	NCH	TH
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.
EVALUATION SYSTEM		W	MAKE-UP MECHANISMS	
Individual written and/or oral tests or individual coding/programming tests		100%	Individual written and/or oral tests or individual coding/programming tests	
Comments: - Control point: minimum grade 5.			Comments: - 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%.	

CH - Class hours: 32 h.
NCH - Non-class hours: 19 h.
TH - Total hours: 51 h.

2RGE293 (2 sem)				
LEARNING ACTIVITIES		CH	NCH	TH
Development and writing of records, reports, presentations, audiovisual material, etc. on		1,34 h.	,66 h.	2 h.

projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams

EVALUATION SYSTEM

W

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

100%

MAKE-UP MECHANISMS

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

Comments: - Continuous assessment. - It may be asked to redo the document.

CH - Class hours: 1,34 h.

NCH - Non-class hours: ,66 h.

TH - Total hours: 2 h.

2RGE291 (2 sem)

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.

EVALUATION SYSTEM

W

Observation (technical capacity, attitude and participation)

100%

MAKE-UP MECHANISMS

Observation (technical capacity, attitude and participation)

Comments: Continuous assessment.

CH - Class hours: 2 h.

NCH - Non-class hours: 1 h.

TH - Total hours: 3 h.

2RGE294 (2 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

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%

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: - Continuous assessment.

CH - Class hours: 1,34 h.

NCH - Non-class hours: ,66 h.

TH - Total hours: 2 h.

RGE227 [!] *Aplica y ajusta los parámetros de controladores básicos en una aplicación simple de control*

LEARNING ACTIVITIES

CH

NCH

TH

Carrying out work experience in real environments and writing the corresponding report

18 h.

4 h.

22 h.

EVALUATION SYSTEM

W

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

20%

MAKE-UP MECHANISMS

Prototype / Product

Comments: - In the project / PBL there will not be any retake of the individual defense.

Individual written and/or oral tests or individual coding/programming tests 50%
Prototype / Product 30%
Comments: - PBL project grade: 30% product, 20% technical content of the report and 50% individual technical defense.

CH - Class hours: 18 h.

NCH - Non-class hours: 4 h.

TH - Total hours: 22 h.

2RGE290 (2 sem)

LEARNING ACTIVITIES

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

CH
2 h.

NCH
1 h.

TH
3 h.

EVALUATION SYSTEM

Observation (technical capacity, attitude and participation) **W** 100%

MAKE-UP MECHANISMS

Observation (technical capacity, attitude and participation)

Comments: Continuous assessment.

CH - Class hours: 2 h.

NCH - Non-class hours: 1 h.

TH - Total hours: 3 h.

CONTENTS

1. Qualitative automation1.1 Automation. Systems control1.2 Concept of system1.3 Control of a system1.4 Behavior of dynamic systems1.5 Basic control actions 2. Modeling of continuous dynamical systems2.1 Mathematical description of system behavior2.2 Transfer function2.3 Graphical representation of systems2.4 Mathematical modeling of physical systems. Examples 3. Temporal response of dynamic systems3.1 Free response and forced response3.2 Transient regime and steady state regime3.3 First order systems3.4 Second order systems3.5 Stability3.6 Controlled system response: accuracy 4. Simulation of dynamic systems4.1 Computer simulation4.2 Internal structure of a simulator4.3 Numerical solution of differential equations4.4 Simulation in Matlab (Control toolbox) and Simulink

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources

Moodle Platform

Bibliography

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