

[GEJ304] CONTROL ENGINEERING

GENERAL INFORMATION

Studies	DEGREE IN INDUSTRIAL ELECTRONICS ENGINEERING		Subject	?	
Semester	1	Course	3	Mention / Field of specialisation	
Character	COMPULSORY				
Plan	2022	Modality	Face-to-face	Language	CASTELLANO/EUSKARA
Credits	4,5	Hours/week	4.22	Total hours	76 class hours + 36.5 non-class hours = 112.5 total hours

PROFESSORS

GARRAMIOLA ALDAY, FERNANDO
 MADINA HERNANDEZ, PATXI

REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
MATHEMATICS III	(No previous knowledge required)
MODELLING, SIMULATION AND CONTROL OF MULTI-PHYSICAL SYSTEMS	

LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
GER306 - To know the fundamentals of automation and control methods: control	x			3,78
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		0,4
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		0,32
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 speciality, at the level necessary to acquire the rest of the competencies of the degree, including notions of the latest advances.
- 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.
- ENA121** - Continued training: Ability to acknowledge the need for their own continued training and to undertake this activity throughout their professional life independently.

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

SECONDARY LEARNING RESULTS

RGE390 [!] *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	2 h.	2 h.	4 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: 2 h.
TH - Total hours: 4 h.

RGE391 [!] *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	1 h.	2 h.	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: 1 h.
NCH - Non-class hours: 2 h.
TH - Total hours: 3 h.

RGE392 [!] *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	1 h.	2 h.	3 h.

EVALUATION SYSTEM

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems *W* 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 h.
NCH - Non-class hours: 2 h.
TH - Total hours: 3 h.

RGE393 [!] *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	2 h.	2 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	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 asked to redo the document.

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

RGE394 [!] *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.	2 h.	4 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: 2 h.
NCH - Non-class hours: 2 h.
TH - Total hours: 4 h.

RGE314 [!] *Modela sistemas lineales y realiza su análisis temporal, de estabilidad y precisión.*

LEARNING ACTIVITIES

	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.	2 h.	4 h.
Computer simulation exercises, individually and/or in teams	4 h.	3 h.	7 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	14 h.		14 h.
Carrying out exercises and solving problems individually and/or in teams	6 h.	3 h.	9 h.

EVALUATION SYSTEM

	W
Individual written and/or oral tests or individual coding/programming tests	100%

Comments: - Each assessment system must be retaken if its mark is lower than 5.0. - To calculate the average mark, the minimum mark for each assessment system must be 3.0, otherwise the lowest mark will be applied.

MAKE-UP MECHANISMS

Individual written and/or oral tests or individual coding/programming tests
Comments: - Students with less than 5 in the control point must retake the exam. - Final note of the control point: control point 25% and retake 75%.

CH - Class hours: 26 h.
NCH - Non-class hours: 8 h.

TH - Total hours: 34 h.

RGE315 [!] *Analiza sistemas de control en el dominio frecuencial y aplica el método de lugar de las raíces.*

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.	1 h.	3 h.
Computer simulation exercises, individually and/or in teams	6 h.	3 h.	9 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	14 h.		14 h.
Carrying out exercises and solving problems individually and/or in teams	5 h.	2,5 h.	7,5 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: - Each assessment system must be retaken if its mark is lower than 5.0. - To calculate the average mark, the minimum mark for each assessment system must be 3.0, otherwise the lowest mark will be applied.		Comments: - Students with less than 5 in the control point must retake the exam. - Final note of the control point: control point 25% and retake 75%.

CH - Class hours: 27 h.

NCH - Non-class hours: 6,5 h.

TH - Total hours: 33,5 h.

RGE316 [!] *Diseña controladores mediante diferentes métodos: FT en lazo cerrado, métodos frecuenciales y lugar de las raíces.*

LEARNING ACTIVITIES	CH	NCH	TH
Practical work in workshops and/or laboratories, individually and/or in teams	10 h.		10 h.
Carrying out work experience in real environments and writing the corresponding report	5 h.	12 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	20%	Prototype / Product
Individual written and/or oral tests or individual coding/programming tests	50%	Comments: - In the project / PBL there will not be any retake of the individual defense.
Prototype / Product	30%	

CH - Class hours: 15 h.

NCH - Non-class hours: 12 h.

TH - Total hours: 27 h.

CONTENTS

A) QUALITATIVE CONTROL

1. Intro: System control concept

B) MODELLING AND TIME RESPONSE

1. Modelling review
2. Time response
 1. Response types
 2. Parameters of the step response

- 3. Time response of 1st and 2nd order systems
- 4. Time response of high order systems
- 3. Controllers

C) SYSTEM ANALYSIS AND ROOT LOCUS

- 1. Stability
 - 1. Routh-Hurwith method
 - 2. Precission
 - 3. Frequency analysis
 - 1. Response in frequency domain
 - 2. Frequency transfer function
 - 3. Graphical representation
 - 4. Procedure for drawing frequency response
 - 5. Interpretation of Bode diagrams
 - 6. Closed loop behaviour
- 4. Root Locus
 - 1. Definition and properties
 - 2. Building proce
 - 5. Closed loop control

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources

- Subject notes
- Moodle Platform
- Class presentations

Bibliography

- Ogata, Katsuhiko. Ingeniería de control moderna 5ªed. Pearson Educación. Madrid 2010. ISBN 9788483226605
- Ogata, Katsuhiko. Problemas de ingeniería de control utilizando Matlab. Prentice-Hall. Madrid 1999. ISBN 84-8322-046-6
- Douglas, Brian. Fundamentals of control theory. Online.
- Nise, Norman S. Control Systems Engineering, 8th edition. Wiley. 2019. ISBN 978-1-119-47422-7
- Åström, Karl J.; Murray, Richard M. Feedback Systems: An Introduction for Scientists and Engineers - Second Edition. Princeton University Press. 2020. ISBN 9780691193984