

## [MSC002] Advanced control of energy systems

### GENERAL INFORMATION

<b>Studies</b>	MASTER DEGREE IN SMART ENERGY SYSTEMS		<b>Subject</b>	Energy management and control
<b>Semester</b>	2	<b>Course</b>	1	<b>Mention / Field of specialisation</b>
<b>Character</b>	COMPULSORY		<b>Language</b>	ENGLISH
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face	<b>Total hours</b>
<b>Credits</b>	4,5	<b>Hours/week</b>	0	63 class hours + 49.5 non-class hours = <b>112.5 total hours</b>

### PROFESSORS

EGUREN ALUSTITZA, IMANOL
GONZALEZ JIMENEZ, DAVID

### REQUIRED PREVIOUS KNOWLEDGE

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

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>MSR071</b> - Design and implement advanced control strategies for energy systems such as digital and multivariable controllers.		x		4,04
<b>MSR171</b> - Ability to work in multidisciplinary teams and in a multilingual environment	x		x	0,14
<b>MSR222</b> - Exhibits, argues and defends the results obtained in the work carried out before a panel of judges			x	0,16
<b>MSR251</b> - Develops a project in the field of energy systems in a practical application context		x		0,16
			<b>Total:</b>	<b>4,5</b>

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

### SECONDARY LEARNING RESULTS

**RMS113** [!] *Diseñar e implementar estrategias avanzadas de control para sistemas energéticos como controladores digitales y multivariables*

#### 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		21 h.	21 h.
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	2 h.		2 h.
Computer simulation exercises, individually and/or in teams	4 h.	8 h.	12 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	57 h.		57 h.
Carrying out exercises and solving problems individually and/or in teams		9 h.	9 h.

#### EVALUATION SYSTEM

	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	33%
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	34%
Individual written and/or oral tests or individual coding/programming tests	33%

#### MAKE-UP MECHANISMS

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

**CH - Class hours:** 63 h.

**NCH - Non-class hours:** 38 h.

**TH - Total hours:** 101 h.

**RMS171** [!] *Es capaz de trabajar en equipos multidisciplinares y en un entorno multilingüe*

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		3,5 h.	3,5 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%	(No mechanisms)	
<b>CH - Class hours:</b> 0 h. <b>NCH - Non-class hours:</b> 3,5 h. <b>TH - Total hours:</b> 3,5 h.			

**RMS222** [!] *Expone, argumenta y defiende ante un tribunal los resultados obtenidos en el trabajo desarrollado*

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		4 h.	4 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%	(No mechanisms)	
<b>CH - Class hours:</b> 0 h. <b>NCH - Non-class hours:</b> 4 h. <b>TH - Total hours:</b> 4 h.			

**RMS251** [!] *Desarrolla un proyecto del ámbito de los sistemas energéticos en un contexto de aplicación práctica*

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		4 h.	4 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%	(No mechanisms)	
<b>CH - Class hours:</b> 0 h. <b>NCH - Non-class hours:</b> 4 h. <b>TH - Total hours:</b> 4 h.			

## CONTENTS

1. Digital Control
  1. Introduction
  2. Signal sampling and reconstruction
  3. Discrete systems
  4. Z-transform
  5. Closed-loop system transfer function
  6. System analysis: stability and accuracy
  7. Digitalization

2. State space control

1. Introduction
2. Change of representation
3. Analysis of linear systems
4. State-space control design and tracking problem

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**LEARNING RESOURCES AND BIBLIOGRAPHY**

**Learning resources**

Subject notes  
Moodle Platform  
Class presentations  
Slides of the subject

**Bibliography**

Acceso online a bibliografía: <https://labur.eus/n6SdS>