

## [MSC001] Storage system

### GENERAL INFORMATION

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

### PROFESSORS

IRAOLA IRIONDO, UNAI
OCA PEREZ, LAURA

### REQUIRED PREVIOUS KNOWLEDGE

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

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>MSR081</b> - Modelling, sizing, implementing and testing storage systems for electromobility and renewable energy applications		x		4,02
<b>MSR171</b> - Ability to work in multidisciplinary teams and in a multilingual environment	x		x	0,12
<b>MSR222</b> - Exhibits, argues and defends the results obtained in the work carried out before a panel of judges			x	0,12
<b>MSR251</b> - Develops a project in the field of energy systems in a practical application context		x		0,24
<b>Total:</b>				<b>4,5</b>

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

### SECONDARY LEARNING RESULTS

**RMS114** [!] *Modelar, dimensionar, implementar y testear sistemas de almacenamiento para aplicaciones de electromovilidad y energías renovables*

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	3 h.		3 h.
Computer simulation exercises, individually and/or in teams	15 h.	20,5 h.	35,5 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	30 h.		30 h.
Carrying out exercises and solving problems individually and/or in teams	12 h.	20 h.	32 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

**CH - Class hours:** 60 h.

**NCH - Non-class hours:** 40,5 h.

**TH - Total hours:** 100,5 h.

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

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		3 h.	3 h.

  

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Prototype / Product	100%	Prototype / Product

**CH - Class hours:** 0 h.  
**NCH - Non-class hours:** 3 h.  
**TH - Total hours:** 3 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	3 h.		3 h.

**EVALUATION SYSTEM**

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

**MAKE-UP MECHANISMS**

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

**CH - Class hours:** 3 h.  
**NCH - Non-class hours:** 0 h.  
**TH - Total hours:** 3 h.

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

**LEARNING ACTIVITIES**

	CH	NCH	TH
Practical work in workshops and/or laboratories, individually and/or in teams		6 h.	6 h.

**EVALUATION SYSTEM**

	W
Prototype / Product	100%

**MAKE-UP MECHANISMS**

Prototype / Product

**CH - Class hours:** 0 h.  
**NCH - Non-class hours:** 6 h.  
**TH - Total hours:** 6 h.

## CONTENTS

Introduction to Storage Systems: Energy Storage Basics Battery management system (BMS), modeling, algorithm and estimation What is a battery pack? Battery pack modeling tool Storage system modeling: Types of models for lithium-ion cells (equivalent circuit models, physics-based models, data-based models) Algorithm and estimation (SoC, SoH) with coulomb counting and Kalman filtering techniques Analysis of experimental profiles and laboratory equipment (experimental characterizations) Causes and effects of the main degradation mechanisms of lithium-ion cells. Sizing: Sizing analysis from lithium-ion cell empirical data using Matlab optimizations.

## LEARNING RESOURCES AND BIBLIOGRAPHY

**Learning resources**

Subject notes  
 Presentations by external Lecturers  
 Labs  
 Moodle Platform  
 Computer practical training

**Bibliography**

Battery Management Systems, Volume I: Battery Modeling (Gregory L. Plett)  
 Battery Management Systems, Volume II: Equivalent-Circuit Methods (Gregory L. Plett)  
 Acceso online a bibliografía: <https://labur.eus/2IQul>