

## [MGB103] ENERGY STORAGE

### GENERAL INFORMATION

<b>Studies</b>	UNIVERSITY MASTER IN ENERGY AND POWER ELECTRONICS	<b>Subject</b>	ADVANCED ELECTRICAL ENERGY TECHNOLOGIES AND PRINCIPLES
<b>Semester</b>	2	<b>Course</b>	1
<b>Character</b>	COMPULSORY	<b>Mention / Field of specialisation</b>	
<b>Plan</b>	2015	<b>Modality</b>	Adapted Face-to-face
<b>Credits</b>	4	<b>Hours/week</b>	2.72
		<b>Language</b>	CASTELLANO
		<b>Total hours</b>	49 class hours + 51 non-class hours = <b>100 total hours</b>

### PROFESSORS

OCA PEREZ, LAURA

### REQUIRED PREVIOUS KNOWLEDGE

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

### SKILLS

#### VERIFICA SKILLS

##### SPECIFIC

**MGC13** - Specification of a storage system and associated circuits

**MGC14** - Evaluation of the technical and economic feasibility of a storage-based solution

##### CROSS

**MGTR10** - To share knowledge, reasoning and conclusions with specialist and non-specialist audiences in clear, unambiguous ways.

**MGTR12** - To analyse complex information and situations in the field of study, considering several solutions for each problem and making the right decision in a given context, taking social and ethical implications into account.

**MGTR13** - To identify product or business development opportunities, managing the human and material resources adequately.

##### BASIC

**M\_CB10** - To have learning skills and the capacity for self-guided or independent subsequent learning.

**M\_CB6** - To have and understand knowledge which provides a base or opportunity to be original in the development and/or application of ideas, often in an investigation context

**M\_CB7** - To know how to apply the acquired knowledge and competencies and the ability to solve problems in new or unfamiliar contexts within wider (or multidisciplinary) environments related to their field of study

**M\_CB8** - To be able to integrate different types of knowledge and make complex judgements based on information that, in spite of being partial or limited, includes ideas on the social and ethical responsibilities associated with the application of knowledge

**M\_CB9** - To share knowledge, conclusions and their rationale with specialised and lay audiences in a clear, unambiguous manner

**MGTR11** - To lead work teams effectively and efficiently in order to achieve common goals.

### LEARNING RESULTS

#### **RMG117** Identifying storage technologies for each application

##### LEARNING ACTIVITIES

Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects

Individual and/or team computer simulation practice

**CH**

4 h.

**NCH**

**TH**

4 h.

4 h.

12 h.

16 h.

##### EVALUATION SYSTEM

Individual written and oral tests to assess technical skills of the subject

Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

**W**

50%

50%

##### MAKE-UP MECHANISMS

Individual written and oral tests to assess technical skills of the subject

Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

**Comments:** Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

**CH - Class hours:** 8 h.

**NCH - Non-class hours:** 12 h.

**TH - Total hours:** 20 h.

**RMG118 Sizing storage systems**

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	5 h.		5 h.
Individual and/or team computer simulation practice	4 h.	16 h.	20 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>
Individual written and oral tests to assess technical skills of the subject	50%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	50%

<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

**Comments:** Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

**CH - Class hours:** 9 h.  
**NCH - Non-class hours:** 16 h.  
**TH - Total hours:** 25 h.

**RMG119 Performs specification converter topologies associated with power storage systems**

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	8 h.		8 h.
Individual and/or team computer simulation practice		10 h.	10 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>
Individual written and oral tests to assess technical skills of the subject	50%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	50%

<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

**Comments:** Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

**CH - Class hours:** 8 h.  
**NCH - Non-class hours:** 10 h.  
**TH - Total hours:** 18 h.

**RMG120 Design management systems batteries and supercapacitors**

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	5 h.		5 h.
Individual and/or team computer simulation practice		5 h.	5 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>
Individual written and oral tests to assess technical skills of the subject	50%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	50%

<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

**Comments:** Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

**CH - Class hours:** 5 h.
   
**NCH - Non-class hours:** 5 h.
   
**TH - Total hours:** 10 h.

**RMG121** Applying energy storage knowledge in a simulated or real environment with PBL methodology

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	19 h.	8 h.	27 h.
Relating to projects/POPBLs carried out individually or in teams			

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**Comments:** Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**CH - Class hours:** 19 h.
   
**NCH - Non-class hours:** 8 h.
   
**TH - Total hours:** 27 h.

**CONTENTS**

Storage systems applications

Grid

Electromobility

Islanding systems

Storage technologies

Flywheels

Ultracapacitors

Lead Acic battery

Nickel battery

LiOn battery

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**Power converters applied to storage systems**

Concepts

Buck-Boost DCDC converter

Interleaved converter

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**LEARNING RESOURCES AND BIBLIOGRAPHY**

**Learning resources**

Moodle Platform  
Subject notes

**Bibliography**

R. Baxter; Energy Storage. A nontechnical guide; PennWell; 2005; ISBN: 978-1593700270  
G. Plett; Battery Management Systems, Volume II: Equivalent-Circuit Methods; Artech House; 2015; ISBN: 978-1630810276  
G. Plett; Battery Management Systems, Volume I: Battery Modeling; Artech House; 2015; ISBN: 978-1630810238