Teaching Guide				
Identifying Data				2020/21
Subject (*)	Energy Storing Systems		Code	770523019
Study programme	Mestrado Universitario en Eficiencia e Aproveitamento Enerxético			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Industrial			
Coordinador	Casteleiro Roca, José Luis	E-mail	jose.luis.casteleiro@udc.es	
Lecturers	Casteleiro Roca, José Luis	E-mail	jose.luis.casteleiro@udc.es	
Web				
General description	This subject aims to give students theoretical knowledge of various types of Energy Storage systems used nowdays.			
Contingency plan	1. Modifications to the contents: - No changes will be made. 2. Methodologies: *Teaching methodologies that are maintained: - Master session. - Problem solving (computes in the evaluation). - Tutored works (computed in the evaluation). *Teaching methodologies that are modified: - Mixed test (computes in the evaluation). It will be changed to exam through Teams / Moodle. - Field trip. It cannot be done. 3. Mechanisms for personalized attention to students: - The Outlook / Teams / Moodle tools will be used to solve the doubts of the students. 4. Modifications in the evaluation: - No changes will be made in the weighting, only in the realization of the mixed test online through Teams / Moodle. 5. Modifications to the bibliography or webgraphy: - No changes will be made.			

Study programme competences / results	
Code	Study programme competences / results
A13	Capacidad para analizar, aplicar y optimizar los sistemas de aprovechamiento energético.
B3	Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación.
B5	Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades.
B6	Buscar y seleccionar alternativas considerando las mejores soluciones posibles.
B10	Potenciar la creatividad.
B13	Aplicar los conocimientos teóricos a la práctica
C1	Adquirir la terminología y nomenclatura científico-técnica para exponer argumentos y fundamentar conclusiones.
C3	Aplicar una metodología que fomente el aprendizaje y el trabajo autónomo.
C5	Adquirir la capacidad para elaborar un trabajo multidisciplinar

Learning outcomes			
Learning outcomes	Study programme competences / results		
Knowing the Energy Storage Systems based on reservoirs	AJ13	BC6 BC13	CC3
Knowing the Energy Storage Systems based on inertial disks	AJ13	BC6 BC10	CC5
Knowing the Energy Storage Systems based on compressed air	AJ13	BC5 BC6	CC5
Knowing the Energy Storage Systems based on hydrogen	AJ13	BC3 BC10	CC1

Contents	
Topic	Sub-topic
Topic 1: Need for energy storage	1.1. The binomial generation-consumption 1.2. Problems of load variation in the power stations
Topic 2: Potential energy storage	2.1. Operating principle 2.2. Storage reservoirs. Pump stations
Topic 3: Kinetic energy storage	3.1. Operating principle 3.2. Inertial storage disks
Topic 4: Energy storage with engines	4.1. Operating principle 4.2. Compressed air
Topic 5: Electrical energy storage	5.1. Operation principle of a battery 5.2. Operation principle of a fuel cell (Hydrogen)

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A13 B6 B13	9	15	24
Laboratory practice	B3 B10 C3 C5	9	10	19
Workshop	B3 B5 B6 B10	3	25	28
Mixed objective/subjective test	B5 B6 C1	3	0	3
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Keynote speech complemented with the use of audiovisual media and the introduction of some questions to students, in order to transmit knowledge and facilitate learning. The order of the topics covered will not have to be the one described in the teaching guide. In addition, there will be topics that can be seen together on the development of others, and the division between them may not be strict.
Laboratory practice	Performing laboratory practice as far as possible; or, failing that, solving exercises and specific problems in the classroom, from the knowledge explained.

Workshop	Realization of an individual work of a specific subject of the subject and sharing in a group to share knowledge. Later the works will be joined in a common one that will be presented in class by groups.
Mixed objective/subjective test	It consists in carrying out an objective test of approximately 3 hours, in which the acquired knowledge will be evaluated.

Personalized attention	
Methodologies	**Description**
Laboratory practice	The student has the relevant meetings of personalized tutorials, to resolve the concerns arising from the matter.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Mixed objective/subjective test	B5 B6 C1	Exam type objective test	60
Laboratory practice	B3 B10 C3 C5	Some tasks established in the subject, within the framework of this methodology	10
Workshop	B3 B5 B6 B10	Accomplishment of an individual and group work, as well as its exhibition in class	30

Assessment comments
As part of the "Laboratory practice" may include aspects such as attendance, personal work, attitude, etc., to help to pass the subject. The "Mixed test" will be divided into a multiple choice and some questions. It is necessary to exceed 15% of the score in the "Mixed test" to pass, as well as to approve the works proposed in "Workshop". Students with recognition of part-time dedication and academic waiver of attendance exemption, second establishes the "NORMA QUE REGULA O RÉXIME DE DEDICACIÓN AO ESTUDO DOS ESTUDANTES DE GRAO NA UDC (Arts. 2.3; 3.b e 4.5) (29/5/212)", will be evaluated in the same way, allowing one more week of margin in the assignments. For the second opportunity, there will be no second deadline for assignments, and the evaluation will be done in a similar way to the first opportunity.

Sources of information	
Basic	- Ter-Gazarian, A. (Andrei) (1994). Energy storage for power systems. Stevenage, Harts., U.K. : P. Peregrinus on behalf of the Institution of Electrical Engineers
Complementary	- Huggins, Robert (2010). Energy storage. New York: Springer

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Evaluation and Optimization of the Energy System Sustainability/770523020 Energy, Cooperation and Sustainability/770523016 Efficiency of Electric Systems/770523013 Quality of the Electric Service/770523014
Other comments
To help achieve an immediate sustainable environment and meet the objective of action number 5: "Healthy and sustainable environmental and social teaching and research" of the "Green Campus Ferrol Action Plan":1. The delivery of the documentary works that are made in this matter: 1.1. They will be requested in virtual format and / or computer support   1.2. They will be made through Moodle, in digital format without the need to print them

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.