| Teaching Guide | | | | |
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| Identifying Data | | | | 2018/19 |
| 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. | | | |

| 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<br>BC13 | CC3 |
| Knowing the Energy Storage Systems based on inertial disks | AJ13 | BC6<br>BC10 | CC5 |
| Knowing the Energy Storage Systems based on compressed air | AJ13 | BC5<br>BC6 | CC5 |
| Knowing the Energy Storage Systems based on hydrogen | AJ13 | BC3<br>BC10 | CC1 |

| Contents | |
|---|---|
| Topic | Sub-topic |
| Topic 1: Need for energy storage | 1.1. The binomial generation-consumption<br><br>1.2. Problems of load variation in the power stations |

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| Topic 2: Potential energy storage | 2.1. Operating principle<br><br>2.2. Storage reservoirs. Pump stations |
| Topic 3: Kinetic energy storage | 3.1. Operating principle<br><br>3.2. Inertial storage disks |
| Topic 4: Energy storage with engines | 4.1. Operating principle<br><br>4.2. Compressed air |
| Topic 5: Electrical energy storage | 5.1. Operation principle of a battery<br><br>5.2. Operation principle of a fuel cell |

| 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 | 0 | 9 |
| Laboratory practice | B3 B10 C3 C5 | 9 | 0 | 9 |
| Workshop | B3 B5 B6 B10 | 3 | 40 | 43 |
| Mixed objective/subjective test | B5 B6 C1 | 3 | 10 | 13 |
| 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.<br>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 | 15 |
| Workshop | B3 B5 B6 B10 | Accomplishment of an individual and group work, as well as its exhibition in class | 25 |

| Assessment comments |
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| As part of the "Laboratory practice" may include aspects such as attendance, personal work, proposed personal work, attitude, etc., to help to pass the subject.<br>The "Mixed test" will be divided into a theoretical and practical part.<br>It is necessary to exceed 50% of the score in the theoretical part of the "Mixed test" to approve, as well as having made and approved the works proposed in the "Laboratory practice" and the ones in "Workshop". |

| 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 |
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| Subjects that it is recommended to have taken before |
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| Subjects that are recommended to be taken simultaneously |
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| Subjects that continue the syllabus |
| Evaluation and Optimization of the Energy System Sustainability/770523020<br>Energy, Cooperation and Sustainability/770523016<br>Efficiency of Electric Systems/770523013<br>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 |