Academic Year/course: 2024/25

66379 - Chemical and electrical storage

Syllabus Information

Academic year: 2024/25
Subject: 66379 - Chemical and electrical storage
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 636 - Master's in Renewable Energies and Energy Efficiency
ECTS: 3.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

The objectives of the subject are the following: to know the different energy storage modes and the flexibility services they can offer to the electric transmission and distribution networks; to know the limitations of their interchangeability; to know the fundamental principles of different mechanical, chemical, electric and magnetic storage systems; to compare the efficiency characteristics of the mentioned systems.

2. Learning results

- Classification of direct and indirect energy storage systems
- Flexibility services of storage systems for transmission and distribution power grids
- Operating principles of mechanical storage systems: PHS, CAES, LAES, FESS
- Operating principles of direct storage systems: supercapacitors and SMES.
- The possible ways of transforming electrical energy into chemical energy through energy carriers such as hydrogen, synthetic natural gas or others.
- The types of storage and transport of hydrogen and other energy carriers and obtaining energy from them.
- The physicochemical processes that take place in the different types of batteries.
- The types of batteries on the market and their prospects for future development.
- Identification of the different types of fuel cells, their field of application and their fundamental characteristics.
- Advantages and limitations associated with different types of electrochemical storage systems.

3. Syllabus

- Energy storage functionalities
- Classification of Electrical Energy Storage Systems
- Mechanical indirect storage systems:
    - Hydraulic pumping (PHS)
    - Compressed air (CAES)
    - Compressed Liquid Air (LAES)
    - Flywheels (FESS)
- Direct storage systems
    - Supercapacitors
    - Superconducting coils
- V2G
- Chemical storage. Power-to-X
    - Hydrogen
        - Procurement processes
        - Storage
        - Energy from hydrogen
    - Methane. Natural gas. Synthetic natural gas
    - Ammonia
    - Methanol
    - Synthetic fuels. Biofuels.
- Electrochemical storage
    - Electrochemical systems
    - Types of batteries. Characteristics. Operating parameters.
    - Comparison of technologies. Future developments.

- System integration
- Economic aspects

4. Academic activities

- Master class: presentation of contents by the teaching staff or external experts to all students of the subject. 15 hours.
- Problem solving and case studies: practical exercises with all the students of the subject. 12 hours.
- Laboratory practice: practical exercises in small groups of students. 3 hours.
- Practical application or research work.12,5 h.
- Self-study by the student. 30 h
- Assessment tests. 2,5h

The hours indicated are only illustrative and will be adjusted depending on the academic calendar.

5. Assessment system

Option 1:

The assessment includes:

- Aassistance and participation in the classroom (A) during the course. It will only be evaluable during the teaching of the subject.
- Completion of between 2 and 4 papers (T) of bibliographic or other types of analysis on specific aspects of the program.

The grade for the subject will be calculated as follows: final grade = $0.2 \times A + 0.8 \times T$

All evaluation categories will be graded out of 10 points.

Option 2 (global assessment):

Students who do not choose Option1, or who opt for the extraordinary call may choose to sit for one exam only. This test may include theoretical questions and/or the resolution of exercises. In this case the grade for the subject will be calculated as 100% of the exam grade.

If the student chooses this option, the minimum grade to pass the subject will be 5.0.

Assessment options 1 and 2 are mutually exclusive.

6. Sustainable Development Goals

7 - Affordable and Clean Energy
9 - Industry, Innovation and Infrastructure
13 - Climate Action