Syllabus

Course Description

Course Title	Electrochemical energy storage and conversion
Course Code	45534
Course Title Additional	
Scientific-Disciplinary Sector	ING-IND/23
Language	English
Degree Course	Master in Energy Engineering
Other Degree Courses (Loaned)	
Lecturers	Dott. Narges Ataollahi, Narges.Ataollahi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/46627
Teaching Assistant	
Semester	Second semester
Course Year/s	2
CP	6
Teaching Hours	60
Lab Hours	0
Individual Study Hours	90
Planned Office Hours	
Contents Summary	To equip students with a comprehensive understanding of the scientific and engineering principles behind modern electrochemical systems used for energy storage and conversion. Through lectures and laboratory work, students will develop theoretical and practical competencies in the design, analysis, and assessment of technologies such as batteries, fuel cells, electrolyzers and supercapacitors. The course prepares students to apply this knowledge in both research and industrial contexts, with a focus on solving real-world energy challenges using electrochemical solutions.

Course Topics	This course covers the principles of electrochemical energy production, storage, and conversion. Main topics include:(i) the study of equivalent circuits, (ii) thermodynamics, (iii) reaction kinetics, (iv) transport phenomena, (v) hydrogen production and use; (vi) applications to batteries, fuel cells, electrolyzers and supercapacitors.
Keywords	Electrochemical Energy Applications, Batteries, Fuel cells, Electrolyzers, Hydrogen
Recommended Prerequisites	General chemistry- Physics: thermodynamics.
Propaedeutic Courses	
Teaching Format	Frontal lectures and Laboratory.
Mandatory Attendance	Laboratory lessons are mandatory.
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding: profound and detailed scientific knowledge and understanding of the principles of equilibrium and non-equilibrium electrochemistry Applying Knowledge and understanding: profound and detailed scientific knowledge of the main electrochemical energy conversion and storage methods Making judgments: skills and problem-solving capacity to analyze problems of electrochemical energy conversion and storage Communication skills: ability to structure and prepare scientific and technical documentation describing project activities Learning skills: ability to independently keep up to date with developments in the most important areas of electrochemical energy conversion and storage.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Evaluation of written reports on lab experiments and oral examinations. The examination consists of either an oral test, or the discussion of a report written by the student on a topic which may be either freely chosen or chosen in agreement with the course lecturer. An alternative method for the exam is building an electrochemical device with given specifications (e.g. A zinc-carbon

	battery which provides a given amount of power for a given time) and discussion of the procedures used and the problems found.
Evaluation Criteria	Showing a sufficient knowledge of the topic and the ability to answer related questions.
Required Readings	One of the following books: Electrochemical Engineering, Thomas F. Fuller and John N. Harb. Water Electrolysis for Hydrogen Production, Pasquale Cavaliere Fundamentals of Electrochemistry, Bagotsky Electrochemistry for material science - Plieth Hydrogen Storage Technology Materials and Applications, ed. Lennie Klebanof Electrochemical Power Sources (Batteries, Fuel Cells and Supercapacitors, ed V.S Bagotsky, A.M Skundin,Y.M Volfkovich
Supplementary Readings	Other files dedicated to specific topics will be indicated or given during the course.
Further Information	Connections with other courses This course is connected with the course Advanced Materials for Energy Engineering (140487), which extends several topics introduced here, with a particular focus on the materials and devices used in energy conversion and storage systems. It's a natural continuation and highly recommended for students who want to explore more about device fabrication and material performance. Professional applications of the covered topics The topics covered are highly relevant for careers in the energy field, particularly in companies and research centers focused on batteries, fuel cells, electrolyzers, and supercapacitors. Students will gain both theoretical knowledge and practical skills useful for R&D, system design, and evaluating electrochemical devices. These are key areas in today's shift towards sustainable energy, like electric mobility, portable electronics, grid storage, and green hydrogen.
Sustainable Development Goals (SDGs)	Affordable and clean energy, Climate action, Responsible consumption and production, Industry, innovation and

	infrastructure