Syllabus

Course Description

Course Title	Electrochemical energy storage and conversion
Course Code	45534
Course Title Additional	
Scientific-Disciplinary Sector	ICHI-01/A
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	18
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 Knowledge of chemistry-physics: thermodynamics
Propaedeutic Courses	
Teaching Format	Frontal lectures and Laboratory.
Mandatory Attendance	Not mandatory but encouraged
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.)	At the end of the course, students should also be able to apply electrochemical principles to practical energy storage and conversion systems, analyse and interpret experimental data, critically assess the performance and limitations of electrochemical devices, and communicate scientific results clearly using appropriate technical terminology.
Assessment	The assessment of the course consists of two components: Formative assessment: preparation of a report based on the laboratory activities. The report may be prepared individually or as

	part of a group. Students who are unable to participate in the laboratory lessons will complete an equivalent individual project or assignment agreed with the lecturer. The work will involve the analysis and interpretation of experimental data and/or scientific literature related to the topics of the course. Weight: 50% of the final grade. ILOs assessed: (2) Applying knowledge and understanding; (3) Making judgments; (4) Communication skills; (5) Learning skills. Summative assessment: presentation and discussion of the laboratory work or individual project, followed by questions on the relevant topics of the course. Weight: 50% of the final grade. ILOs assessed: (1) Knowledge and understanding; (2) Applying knowledge and understanding; (3) Making judgments; (4) Communication skills.
Evaluation Criteria	The final mark is calculated as the weighted average of the laboratory report or individual project (50%) and the presentation and oral discussion (50%). Both components must receive a positive evaluation. The laboratory report or individual project will be evaluated based on scientific correctness and completeness, appropriate application of the methods discussed during the course, accuracy of data analysis, interpretation and critical discussion of the results, problem-solving ability, and clarity and quality of the written work. The presentation and oral discussion will be evaluated based on knowledge and understanding of the course topics, ability to connect theoretical principles with practical applications, ability to critically discuss the work and justify the adopted approach, appropriate use of scientific and technical terminology, clarity of the presentation, and accuracy of the answers to 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 • Handbook of Batteries - D. Linden, T. B. Reddy Editors • 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	Students who are unable to participate in the laboratory lessons will complete an equivalent individual project or assignment agreed with the lecturer. 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