Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Electrochemical Energy Storage and Conversion
Course code	45534
Scientific sector	ING-IND/23 "Applied Physical Chemistry"
Degree	Master Energy Engineering
Semester	2
Year	1
Academic year	2021/2022
Credits	6
Modular	no

Total lecturing hours	24
Total lab and exercise hours	36
Attendance	Attendance to at least 75% laboratory lessons is mandatory
Recommended preliminary knowledge	Bachelor level courses: chemistry and physics with basic thermodynamics; materials science and technology
Connections with other courses	This course links with the course of Advanced Materials for Energy Engineering (45503), extending and discussing in detail many of the available electrochemically based energy systems. These include electrochemistry applications in the production, storage and conversion of energy, such as in hydrogen fuel cells and batteries, including the assessment of the efficiency and sustainability of the electrochemical energy systems.
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Specific educational objectives	The course aims to introduce the main applications of electrochemical energy production, storage and conversion. Special emphasis is given to hydrogen, as a green energy vector, its production and use according to the specific guidelines of the European Green Deal, and actions necessary to match the emission reductions target for 2030, and make European climate neutral in 2050. Students will learn of the main types of electrochemical energy conversion and storage devices on the market, understand their specificity, impact on the environment, and learn of the sustainability of different solutions. The main industrial electrochemical technologies dedicated to energy production and storage are presented and analyzed through lectures, laboratory experiments and, if possible, visits to industrial plants.

Lecturer	Narges Ataollahi
Scientific sector of the lecturer	ING-IND/22
Teaching language	English
Office hours	By appointment
Teaching assistant *(if any)*	to be defined
Office hours	-
List of topics covered	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, and supercapacitors.
Professional applications of the covered topics	The course contributes to the training of engineers working in the field of renewable energy production, storage and conversion, both in private companies and in R&D institutes
Teaching format	Frontal lectures and exercises

Learning outcomes	**(1) Knowledge and understanding:** profound and detailed scientific knowledge and understanding of the principles of electrochemistry **(2) Applying Knowledge and understanding:** main applications in electrochemical energy production, storage and conversion systems **(3) Making judgments:** skills and problem-solving capacity to analyze real cases of electrochemical energy storage and conversion **(4) Communication skills:** ability to structure and prepare scientific and technical documentation describing project activities **(5) Learning skills:** ability to independently work and update on developments in the most important sectors of electrochemical energy production, storage and conversion
Assessment	The formative assessment includes the preparation of a report on laboratory activity as a group or developing a project on one of the course's topics which can be done individually. The assessment is based on the evaluation of the report or project. The summative assessment will be based on the preparation of practical laboratory activity or project and assessed by a PowerPoint presentation given by the student, and evaluated by questions and discussion.

Formative assessment

Form	Length /duration	ILOs assessed
Development of a report on laboratory activity / project on a course topic	During the course	(2), (3), (5)

Summative assessment

Form	%	Length /duration	ILOs assessed
Presentation and discussion of the developed report	100	About 1 hour	All except (5).

Assessment language	English
Evaluation criteria and criteria for awarding marks	The evaluation criteria are based on the accurate performance of laboratory activities or methodology and accuracy of results elaboration. The affirmative evaluation of laboratory activities (based on reports or projects) is required to proceed with the oral exam. The oral exam is based on a PowerPoint presentation which will be evaluated by quality and nature of presentation and ability to answer the related questions. The final mark is based on both lab activity and oral exam (50-50).

Required readings	One of the following books: • Bianchi e Mussini- Elettrochimica - ed. Masson • Bianchi – Processi elettrochimici - ed. Masson D'Archer e Hill (Eds) • 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 Other files dedicated to specific topics will be indicated or given during the course.
Supplementary readings	Other files dedicated to specific topics will be indicated or given during the course.