



Module	<i>Advanced Electrochemical Energy Storage Systems</i>
Code	
Instruction language	English
ECTS credits	3
Credit hours	2
Duration	1 semester
Cycle	Summer semester
Coordinator	
Lecturer	Dr. Montaha Anjass
Allocation to study programmes	Chemistry M.Sc., elective module Wirtschaftschemie M.Sc., elective module Energy Science and Technology M.Sc., elective module Physics M.Sc., elective module, 1 st or 2 nd semester Advanced Materials M.Sc., elective module, 1 st – 3 rd semester
Formal prerequisites	
Recommended prerequisites	Basics in Electrochemistry
Learning objectives	Students who have completed this module: <ul style="list-style-type: none">• gain more understanding of the fundamentals and advances of solid-state electrochemistry.• have distinctive knowledge of structure and property relationships in specific redox-active compounds.• are aware of the limitations of the current electrochemical energy storage systems• are Familiar with the current development of different energy storage technologies.
Syllabus	The following topics are part of the course: <ol style="list-style-type: none">1. Fundamental electrochemical concepts:<ul style="list-style-type: none">• Current-potential measurements• Galvanostatic charge-discharge• Charge-storage and transfers• Gravimetric and volumetric energy density• Electrochemical Impedance Spectroscopy2. Electrochemical energy storage systems<ol style="list-style-type: none">2.1 Li-ion Batteries<ul style="list-style-type: none">• Basic principles• Electrode materials• Challenges and current limitations2.2 Post-Li Batteries<ul style="list-style-type: none">• Monovalent charge carriers (Na-ion batteries)• Multivalent charge carriers (Mg-ion Batteries)<ul style="list-style-type: none">▪ Advantages/Challenges



- Electrode Materials(intercalation/conversion)
 - Electrolyte
- 2.3 Redox flow battery (RFB)
- Aqueous RFB
 - Non-aqueous RFB

2.4 Supercapacitors

Literature	<ul style="list-style-type: none">• Vladislav V. Kharton, Solid State Electrochemistry I, Fundamentals, Materials and their Applications, WILEY-VCH, Weinheim, 2009.• Allen J. Bard, Larry R. Faulkner, ELECTROCHEMICAL METHODS Fundamentals and Applications, John Wiley & Sons, New York, 2001.• Selected publications
Teaching and learning methods	Lecture (2 h/week)
Workload	30 hours lecture (attendance time) 60 hours self-study and exam preparation Total: 90 hours
Assessment	Written or oral examination. Form and scope of the examination is determined and notified by the lecturer at the beginning of the course.
Examination	
Grading procedure	The module grade is the examination grade.
Basis for	-
