

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MINERAL RESOURCES ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MRE925	SEMESTER	9
COURSE TITLE	ELECTROCHEMICAL ENGINEERING		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
<i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>			
Lectures		3	4
Labs		1	1
Total		4	5
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Required elective, <i>special background</i>		
PREREQUISITE COURSES:	MRE202, MRE303, MRE405, MRE707		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/MRE187/		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> • <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i> • <i>Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i> • <i>Guidelines for writing Learning Outcomes</i> 								
<p>❖ Students should be able to:</p> <ul style="list-style-type: none"> • Describe the scope and range of electrochemical engineering • Describe in detail the techniques used for the electrochemical characterization of charged interfaces • Identify methods used for promoting research on electrochemical processes • To apply their knowledge of thermodynamics, transport phenomena, basic chemistry and material science in analyzing electrochemical systems of their interest • Become familiar with the use of computational tools (MATLAB, COMSOL, EXCEL, Mathematica) in modeling the behavior of electrochemical systems 								
<p>General Competences</p> <p><i>Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?</i></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i></td> <td style="width: 50%; border: none;"><i>Project planning and management</i></td> </tr> <tr> <td style="border: none;"><i>Adapting to new situations</i></td> <td style="border: none;"><i>Respect for difference and multiculturalism</i></td> </tr> <tr> <td style="border: none;"><i>Decision-making</i></td> <td style="border: none;"><i>Respect for the natural environment</i></td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;"><i>Showing social, professional and ethical responsibility and</i></td> </tr> </table>	<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>	<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>	<i>Decision-making</i>	<i>Respect for the natural environment</i>		<i>Showing social, professional and ethical responsibility and</i>
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<i>Decision-making</i>	<i>Respect for the natural environment</i>							
	<i>Showing social, professional and ethical responsibility and</i>							

<i>Working independently</i>	<i>sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>	<i>.....</i>
<i>Production of new research ideas</i>	<i>Others...</i>
	<i>.....</i>

Search for, analysis and synthesis of data and information, with the use of the necessary technology
 Working independently
 Team work
 Working in an interdisciplinary environment
 Criticism and self-criticism
 Production of new Research ideas
 Production of free, creative and inductive thinking
 Showing social, professional and ethical responsibility

(3) SYLLABUS

Scope and range of electrochemical engineering
 Basic principles of electrochemistry
 Electrodes and charge transport between electrified interfaces
 Electrode kinetics
 Mechanisms of mass transport in electrolyte solutions
 Current distribution and simultaneous mass transport in electrochemical systems
 Porous and semiconductor electrodes
 Design considerations of electrochemical industrial reactors
 Applications in mineral enrichment processes
 Extractive metallurgy and metal refining processes
 Electrodeposition
 Metal electroplating
 Aluminum and magnesium electrolytic processes
 Electrochemical energy systems

(4) TEACHING and LEARNING METHODS - EVALUATION

<p>DELIVERY <i>Face-to-face, Distance learning, etc.</i></p>	<p>Face-to-face, Distance learning, Lectures, Computational EXCEL-Mathematica or MatLab Lab, Tutorials, Lab demonstrations</p>	
<p>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<p>E-Class, electronic communication, video demonstrations, intermediate exams via e-Class tools</p>	
<p>TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<p>Activity</p>	<p>Semester workload</p>
	<p>Lectures</p>	<p>36</p>
	<p>Computational and Demonstration Lab</p>	<p>20</p>
	<p>Tutorials</p>	<p>20</p>
	<p>Self-study</p>	<p>24</p>
	<p></p>	<p></p>
	<p></p>	<p></p>
<p>Course total</p>	<p>100</p>	
<p>STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Final exam (40%, minimum required grade =4/10), Computational and /or literature review and/or laboratory project (60%)</p>	

(5) SUGGESTED BIBLIOGRAPHY

- Suggested bibliography:
1. Εισαγωγή στην ηλεκτροχημεία, by Κυρατζής Νικόλαος – Ευριπίδης, Κωδικό στον Εύδοξο: 11262, ISBN: 960-431-953-1 Εκδότης: Ζήτη Πελαγία & Σια Ι.Κ.Ε.
 2. FUEL CELL FUNDAMENTALS Third Edition, by RYAN O'HAYRE, SUK-WON CHA, WHITNEY G. COLELLA, FRITZ B. PRINZ, ISBN: 9781119113805, Εκδότης: 2016 by John Wiley & Sons, Inc.
 3. MODERN ELECTROCHEMISTRY, SECOND EDITION, by JOHN O' M. BOCKRIS AND AMULYA K.N. REDDY, ISBN: 0-306-46325-3, Εκδότης: 2000 Kluwer Academic/Plenum Publishers, New York
 4. INTRODUCTION TO ELECTROCHEMISTRY, by D. BRYNN HIBBERT, ISBN: 0-333-56303-4, Εκδότης: 1993 MACMILLAN PRESS LTD, London UK
 5. Electrochemical Systems, Third Edition, by John Newman, Karen E. Thomas-Alyea, ISBN: 0-471-47756-7, Εκδότης: 2004 by

John Wiley & Sons, Inc.

6. *FUNDAMENTALS OF ELECTROCHEMISTRY, SECOND EDITION*, by V.S. BAGOTSKY, ISBN: 978-0-471-70058-6, Εκδότης: 2006 by John Wiley & Sons, Inc.

7. *Electrochemical Methods: Fundamentals and Applications, 2nd Edition*, by Allen J. Bard, Larry R. Faulkner, ISBN: 978-0-471-04372-0, Εκδότης: December 2000 by John Wiley & Sons, Inc. (<https://www.wiley.com/en-us/Electrochemical+Methods%3A+Fundamentals+and+Applications%2C+2nd+Edition-p-9780470452530R120>)

8. *Electrochemical Engineering*, by Thomas F. Fuller, John N. Harb, ISBN: 978-1-119-00425-7, Εκδότης: March 2018 by John Wiley & Sons, Inc.

9. *Electrochemical Engineering Science and Technology in Chemical and Other Industries*, by Wendt, Hartmut, Kreysa, Gerhard, ISBN: 978-3-540-64386-9, Εκδότης: 1999 Springer-Verlag Berlin Heidelberg.(10.1007/978-3-662-03851-2)

10. *Introduction to Electrochemical Science and Engineering*, by Serguei N. Lvov, Gerhard, ISBN: 9781466582859, Εκδότης: Published January 8, 2014 by CRC Press.

11. *Electrochemistry and Electrochemical Engineering*, Edited by Lenny Hart, ISBN: 978-1-9789-0650-1, Εκδότης: 2018 Library Press, New York.

12. *Electrochemistry and Electrochemical Engineering. An Introduction*, by West, Alan C., ISBN: 9781470076047, Εκδότης: CreateSpace Independent Publishing Platform, 2012

- Related academic journals::

1. *Journal of Chemical Education* (<https://pubs.acs.org/journal/jceda8>)

2. *Journal of The Electrochemical Society*

3. *ECS Transactions*

4. *Advances in Electrochemical Sciences and Engineering*

5. *Journal of Electrochemical Science and Engineering*

6. *Current Opinion in Electrochemistry*

7. *The Electrochemical Society Interface*

8. *Electrochemical and Solid State Letters*

9. *Journal of New Materials for Electrochemical Systems*

10. *SCIENCE*

11. *Ionics*

12. *Journal of Electroceramics*

13. *ECS Journal of Solid State Science and Technology*