

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MINERAL RESOURCES ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MRE892	SEMESTER	8
COURSE TITLE	MINERAL RESOURCES & CERAMIC FUEL CELLS		
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		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/MRE175/		

(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"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes
<ul style="list-style-type: none"> ❖ Students should be able to: ❖ Appreciate the advantages of ceramic fuel cells operating on available mineral resources ❖ Identify the basic electrochemical characterization tools of ceramic fuel cells ❖ Describe known methods regarding research work on ceramic fuel cells ❖ Show the ability to apply thermodynamic and transport phenomena principles in modeling the operation of ceramic fuel cells ❖ Apply materials science and solid state chemistry knowledge on materials selection for ceramic fuel cells ❖ Know the extent of the use of computational tools such as MATLAB, COMSOL, EXCEL, Mathematica in modeling the operation of ceramic fuel cells ❖ Identify the basic physicochemical principles of the existing fabrication methods for components for ceramic fuel cells and identify differences and innovation approaches
<p>General Competences</p> <p><i>Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma</i></p>

Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information,
with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and
sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
.....
Others...
.....

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

Principles of operation of ceramic fuel cells, history, advantages and disadvantages with respect to other types of fuel cells
Environmental benefits, temperature range of operation
Materials and methods of component fabrication, innovative methods of fabrication of electrolytes and electrodes
Electrochemical characterization of button elementary cells, types of suitable fuels, use of coal and/or gaseous or liquid hydrocarbons in ceramic fuel cells
Remaining research challenges for a wider adoption of ceramic fuel cells to the electrical grid and/or distributed power generation applications
Levels of mathematical modeling of ceramic fuel cells
Ceramic electrolysis cells

(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></p>	<p></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. Fuel Cells Problems and Solutions, by Vladimir S. Bagotsky, ISBN: 978-0-470-23289-7, Εκδότης: 2009 by John Wiley & Sons, Inc.
 5. INTRODUCTION TO ELECTROCHEMISTRY, by D. BRYNN HIBBERT, ISBN: 0-333-56303-4, Εκδότης: 1993 MACMILLAN PRESS

LTD, London UK

6. *SCIENCE AND TECHNOLOGY OF CERAMIC FUEL CELLS*, by NGUYEN QUANG MINH, TAKEHIKO TAKAHASHI, ISBN: 044489568X, Εκδότης: 1995 Elsevier Science B.V. , The Netherlands

7. *Fuel Cells and Their Applications*, by Karl Kordesch, Gunter Simader, ISBN: 3-527-28579-2, Εκδότης: VCH Verlagsgesellschaft mbH, D- 69451 Weinheim, Federal Republic of Germany, 1996

8. *FUEL CELLS From Fundamentals to Applications*, by Supramaniam Srinivasan, ISBN: 978-0387-25116-5, Εκδότης: 2006 Springer Science+Business Media, LLC

9. *Electrochemical Systems, Third Edition*, by John Newman, Karen E. Thomas-Alyea, ISBN: 0-471-47756-7, Εκδότης: 2004 by John Wiley & Sons, Inc.

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

11. *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>)

- Related academic journals::

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

2. *Journal of The Electrochemical Society*

3. *ECS Transactions*

4. *Renewable Energy*

5. *International journal of hydrogen energy*

6. *Engineering*

7. *The Electrochemical Society Interface*

8. *Electrochemical and Solid State Letters*

9. *NATURE*

10. *SCIENCE*

11. *Ionics*

12. *Journal of Electroceramics*

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