COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	EN15	**SEMESTER**	7th Semester
COURSE TITLE	Renewable Energy Sources		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	3	3
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Background
PREREQUISITES:	NO
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass2.emt.duth.gr/courses/CHEM-N1102/

(2) LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

Alternative forms of energy, often referred to as mild forms of energy or renewable energy sources, are perhaps the most important effort to solve two fundamental problems facing the planet: the gradual depletion of traditional energy sources (fossil fuels) and the reduction of environmental pollution from the use of traditional energy sources.
The course examines the following alternative forms of energy and alternative energy technologies:
solar energy, wind energy, water energy, geothermal energy, hydrogen production, bioenergy, and in particular, state-of-the-art photovoltaic cells (Dye sensitized solar cells (DSSC) , Organics Photovoltaics (OPV), and Hybrid Photovoltaics (HPV)).
Demonstration of laboratory exercises in the above-mentioned areas is an integral part of the training.

General Skills
Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,
ICT Use
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Critical thinking
Promoting free, creative and inductive reasoning

Production of new research ideas
• Searching, analyzing, and presenting data and information • Decision making • Adapting to new situations • Project planning and management • Working independently • Teamwork • Respect for the natural environment

(3) COURSE CONTENT

1. Climate change
2. General information on conventional and renewable energy sources, the present and future of renewable energy sources. Energy balance. Contribution of energy sources. Energy conversions. Energy consumption.
3. Solar energy. Introduction. Solar radiation. Solar geometry. Applications of solar energy.
4. Wind energy. Introduction. Wind potential. Wind turbines. Biomass – Bioenergy. Biofuels. Energy utilization of biomass.
5. Geothermal energy. Introduction. Electricity generation. Applications. Utilization of geothermal fields. Rational use of geothermal energy.
6. Small hydroelectric projects. Environmental approach to small hydroelectric projects. Development and construction. Applications.
7. Energy from sea waves. Hydrogen fuel cells.
8. Photovoltaic energy production. Basic characteristics. Operating principles. Construction of photovoltaic systems.
9. Generations of photovoltaics. First generation (monocrystalline silicon (SC-SI), polycrystalline silicon (MC-SI), gallium arsenide (GA-AS). Advantages & disadvantages.
10. Second generation (thin-film photovoltaic cells (amorphous silicon (a-SI), cadmium telluride (Cd-Te), Copper Indium Diselenide (CIS), Copper Indium Gallium Diselenide (CIGS)). Advantages & disadvantages.
11. Use of stored energy to cover part of the laboratory's energy needs. Preparation of a study
12. Hydrogen device. Trends & global developments. Use of hydrogen for energy production in a fuel cell, derived from electrolysis.
13. Measurements and construction of the hydrogen fuel cell power curve. General conclusions – recommendations

(4) LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Face to face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	Use of ICT in Teaching Use of ICT in Communication with students
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.* *Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.*	

Activity	Workload/semester
Lectures	35
Bibliographic research & analysis	20
Project	45
Total	100

The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.	
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	Final exam during exam periods. Assessment Methods: - Written exam with short-answer questions (formative, summative), - Written Assignment (Formative, Summative), - Public Presentation (Formative, Summative)

(5) SUGGESTED BIBLIOGRAPHY

1. ΑΝΑΝΕΩΣΙΜΕΣ ΠΗΓΕΣ ΕΝΕΡΓΕΙΑΣ, Δ. Ασημακόπουλος, Γ. Αραμπατζής, Α. Αγγελής-Δημάκης, Α. Καρταλίδης, Γ. Τσιλιγκιρίδης, 1η έκδοση 2015, Κωδικός Βιβλίου στον Εύδοξο: 41963205.
2. ΑΝΑΝΕΩΣΙΜΕΣ ΠΗΓΕΣ ΕΝΕΡΓΕΙΑΣ και εφαρμογές των Ηλεκτρονικών Ισχύος, Ιορδάνης Ν. Κιοσκερίδης, 1η έκδοση 2019, ISBN: 978-960-418-852-9.
3. RENEWABLE ENERGY RESOURCES, J. Twidell and T. Weir, 3η έκδοση 2015, ISBN-13: 978-0415584388.
4. ORGANIC PHOTOVOLTAICS, Dr. Christoph Brabec, Prof. Dr. Vladimir Dyakonov, Prof. Dr. Ullrich Scherf, ISBN:9783527316755, Online ISBN:9783527623198, 2008 Wiley-VCH Verlag GmbH & Co. KGaA.
5. Ενέργεια, Περιβάλλον και Αειφόρος Ανάπτυξη, Α. Πολυζάκης, 2η έκδοση, ISBN- 978-618-83590--

Related scientific journals:

International Journal of Energy Research
Solar Energy
Renewable Energy