1.1.1 Renewable Energy Sources (geothermal, hydroelectric works)

GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	CIVIL ENGINEERING		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	ΥΔΡ010	**SEMESTER**	8th
COURSE TITLE	Renewable Energy Sources (geothermal, hydroelectric works)		

INDEPENDENT TEACHING ACTIVITIES *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*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Scientific Field
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	

LEARNING OUTCOMES

Learning outcomes

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.

Consult Appendix A

- *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*

Upon successful completion of the course, the student will be able to:

- understand the basic principles of energy technologies and energy mix, and determine the energy balance
- identify and estimate geothermal energy potential
- calculate hydraulic losses of hydroelectric projects
- plan the general layout and siting of hydroelectric projects
- compose technical-economic reports/studies and explain the performance of geothermal energy exploitation systems
- evaluate the performance and functionality of small and large hydroelectric projects

General Competences

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?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism

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*	*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…* *…….*

- Research, analysis and synthesis of data and information
- Adaptation to new situations
- Decision making
- Individual work
- Work in an interdisciplinary environment
- Project planning and management
- Respect for the natural environment
- Promotion of free, creative, and inductive thinking

SYLLABUS

The course aims to provide students with the basic theoretical background for the course 'ΥΔΡ010 Renewable energy sources (geothermal, hydroelectric projects)'. It includes the necessary material for understanding: (a) the existence of geothermal energy sources as well as the calculation of the required technical infrastructure for their utilization and (b) the preliminary design of small and large hydroelectric projects.

Content of lectures:

- Energy. Basic principles of energy technologies. Energy mix. Renewable energy sources. Electricity balance. Temporal variation of consumptions. Energy production distinction.
- Introduction to geothermal terminology. Heat sources inside the Earth. Types of geothermal fields and potential uses. Advantages and disadvantages.
- Hydrothermal deterioration. Sampling of geothermal fluids. Stages of geothermal research.
- Usage of geothermal energy. High and low enthalpy geothermal energy (production of fluids and energy, networks, impact). Technical problems in the exploitation of geothermal energy.
- Financial – Technical elements of geothermal applications. Utilization of geothermal energy in Greece. Locating and evaluating geothermal energy sources.
- Principles and fundamentals of hydroelectric technology. Hydraulic losses. Types of turbines and their mechanical characteristics. Hydroelectric projects (water intakes, intake pipes, generating stations, escape pipes, spillways, gate barriers).
- Preliminary design of large hydroelectric projects (general layout, technical parameters, environmental issues, operation, and optimization).
- Small hydroelectric projects (technology, design, water abstractions, pipelines, reservoirs, environmental issues, hydrological planning).

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face.	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Learning process support (teaching and communication with students) through PowerPoint lectures, through the online course website, through the electronic e-learning platform and through additional electronic communication with students (online announcements and comments, emails, etc.). Additional material (lecture presentations, educational videos, useful sites, and scientific articles) posted on e-learning. Teacher-student collaboration time either in person or via teleconference.	
TEACHING METHODS	***Activity***	***Semester workload***

The manner and methods of teaching are described in detail. *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.* *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*	Lectures: 36 Practice/exercises: 16 Project(s): 10 Educational visit: Individual study: Course total (26 hours workload per ECTS credit): ***130***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Evaluation Language: Greek Written Examination with Extended Response Questions (Formative and/or Conclusive) Theory Assessment (80% of the final grade): • Written progress exam (20% of the final grade) which includes: o Extended Response Theoretical Questions (Formative and/or Inferential) o Solving problems-exercises • Final written exam (60% of the final grade) which includes: o Extended Response Theoretical Questions (Formative and/or Inferential) o Solving problems-exercises Individual work (20% of the final grade) This course description text with the evaluation criteria is accessible to students in the Department's study guide (Department website) and on the course's website. The outline is communicated orally to the students during the first lecture.

ATTACHED BIBLIOGRAPHY

- Phytikas, M., Andritsos N., Geothermal Energy, TZIOLA Publications, 2004, ISBN: 978-960-418-019-6. Book Code in Eudoxos: 18549096 [in Greek].
- Karydakis G., GEOTHERMAL ENERGY, ATHLOTYPO Publications, 2005, ISBN: 960-7378-65-2. Book Code in Eudoxos: 2621 [in Greek].
- Vrachopoulos M., NORMAL GEOTHERMAL - PRINCIPLES OF GEOTHERMAL SYSTEM DESIGN AND APPLICATIONS, Publications Greek Academic Electronic Books and Aids - "Kallipos" Repository, 2016, ISBN: 978-960-603-270-7. Book Code in Eudoxos: 320348 [in Greek].
- Papantonis D., Small hydroelectric projects, Tsotras Publications, 2016, ISBN: 978-618-5066-46-8. Book Code in Eudoxos: 50661021 [in Greek].
- Koutsoyiannis D., Xanthopoulos Th., Technical Hydrology, Publications Greek Academic Electronic Books and Aids - "Kallipos" Repository, ISBN: 978-960-603-506-7. Book Code in Eudoxos: 59390290 [in Greek].