COURSE OUTLINE Water as renewable energy sources

EDUCATION LEVEL	7		
CODE	WBCC-531op	SEMESTER	2nd
TITLE	Water as renewable energy sources		
TEACHING ACTIVITIES	HOURS/WEEK	ECTS	
Lectures, Practice exercises, Field work	3	6	
TYPE OF COURSE	Elective course (in both specializations)		
PREREQUISITE KNOWLEDGE	-		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek		
AVAILABILITY TO ERASMUS STUDENTS	-		
WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL580/		

LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The course consists of a theoretical part and practical exercises that contribute to the understanding of real applications related to the simulation of the operation of pumped storage projects. The course covers a broad subject related to water resources, the temporal distribution of demand and coverage of water needs, fundamental hydropower concepts and hydro turbines. Upon successful completion of the course, postgraduate students will be able to: Estimate the characteristic dimensions of hydroelectric project design. Manage data on time allocation of energy, the marginal price problem, the operation of the energy exchange market and energy demand/supply. Classify the hydroelectric projects, based on the alternative ways of categorizing them (size, purpose, existence of reservoir, etc.). Understand the concept of efficiency and capacity factor. Know the fundamental parts of a dam, as well as the characteristic levels/curves/volumes and apply the water balance equation and the corresponding level-volume relationships at different time distributions. Formulate mathematically the preliminary design of a hydroelectric project and the corresponding basic design rules. Formulate mathematically in a simple way the calculation of the energy losses of a hydroelectric project. Know the different types of hydro turbines available, their operating range and how to select them based on the hydraulic load-discharge diagram. Understand hybrid systems superficially and realize their main benefits, regarding the management and storage of energy. • Realize the effects of climate change on the management of water resources and understand the need to use hybrid systems of renewable energy sources.

Generic Competences
Search, analyze and synthesize data and information Literature review Decision making Process understanding Individual work Project planning and management - Cultivating respect for the natural environment

COURSE CONTENT

The lack of sufficient energy reserves is one of the most important problems of modern society. Energy is one of the most basic social goods, necessary for human existence and therefore the storage of this energy for its correct time distribution is a permanent challenge. In modern times, a decrease in fossil fuels is observed, creating the need to use new forms of energy, renewable energy sources for both energy production and its storage. The proper management of the ever-decreasing water resources is considered a particularly serious issue and is where it makes the use of hydroelectric projects for energy storage a necessary and optimal solution. The objective of this course is to initially provide students with the opportunity to understand the temporal distribution of energy demand and supply, to understand the numerous application possibilities of hydroelectric projects, to explore various fundamental concepts regarding the simulation and operation of hydroelectric projects. Case studies will be highlighted throughout the course to illustrate the real-world conditions and challenges faced by water managers, as well as ways to utilize hydroelectric projects as a form of energy storage, making smart and optimized use of available water resources with respect for the environment.
Educational objects:
Explaining the importance of green energy, combined with the proper management of available water resources.
Learning the fundamental concepts associated with the design of hydro pumped storage projects.

Learning how hydro turbines work and how to choose the right type for the project.
• Studies and construction techniques of hydroelectric projects and reservoirs.

LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

<table>
<tr><td>MODE OF DELIVERY</td><td>Distance learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td><td>In Teaching:
– Presentations using multimedia (images, animation, video).
– Completion of questionnaires.
– PowerPoints (ppt) uploads in the e-class platform.
In Communication with students:
– Support of the learning process through the electronic platform e-Class (announcements, information, messages, documents, assignments, questionnaires, exercises, diary, user groups, multimedia, links, grading, e-book, etc.), and through personal contact.</td></tr>
<tr><td>PLANNED LEARNING ACTIVITIES</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>3 hours x 13 weeks</td></tr><tr><td>Practice Exercises</td><td>20 hours</td></tr><tr><td>Individual Project</td><td>40 hours</td></tr><tr><td>Studying</td><td>40 hours</td></tr><tr><td>Total</td><td>139 hours</td></tr></table></td></tr>
<tr><td>ASSESSMENT METHODS AND CRITERIA</td><td>EXAM 80% (Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving)
INDIVIDUAL PROJECT 20% (AFTER A JOINT DECISION WITH THE STUDENTS)</td></tr>
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TEXTBOOKS - BIBLIOGRAPHY

Papantonis, D.E., Small Hydroelectric Projects, 456 p., Editions Simeon, Athens, 2008 (In Greek)

Efstratiadis A., Tsoukalas I., and Koutsoyiannis D., Generalized storage-reliability-yield framework for hydroelectric reservoirs, Hydrological Sciences Journal, 66(4), 580-599, doi:10.1080/02626667.2021.1886299, 2021

Voros N.G., Kiranoudis C.T., Maroulis Z.B., Short-cut design of small hydroelectric plants, Renewable Energy, Volume 19, Issue 4, 2000, Pages 545-563, ISSN 0960-1481

Yüksek Ö., Kaygusuz K., Small Hydropower Plants as a New and Renewable Energy Source, Energy Sources, Part B: Economics, Planning, and Policy, 1:3, 279-290, 2006, DOI: 10.1080/15567240500397976

Tsoutsos T., Efpraxia M., Mathioudakis V., Sustainable siting procedure of small hydroelectric plants: The Greek experience, Energy Policy, Volume 35, Issue 5, 2007, Pages 2946-2959, ISSN 0301-4215

Jawahar C.P., Prawin A.M., A review on turbines for micro hydro power plant, Renewable and Sustainable Energy Reviews, Volume 72, 2017, Pages 882-887, ISSN 1364-0321

Paish O., Small hydro power: technology and current status, Renewable and Sustainable Energy Reviews, Volume 6, Issue 6, 2002, Pages 537-556, ISSN 1364-0321