

GEOTHERMAL - BIOENERGY - COGENERATION - SMART GRIDS

COURSE OUTLINE

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.9.016.0	SEMESTER	1st
COURSE TITLE	Geothermal - Bioenergy - Cogeneration - Smart grids		
INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	WEEKLY TEACHING HOURS	CREDITS	
	4	6	
Total	4	6	
COURSE TYPE general background, special background, specialised general knowledge, skills development			
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			
2. LEARNING OUTCOMES			
Learning outcomes			
This course examines forms of Renewable Energy Sources, such as Geothermal Energy and Bioenergy from Biomass, Biofuel or Biogas. Advanced energy systems that contribute to rational energy use and the maximization of energy efficiency are also examined, such as Cogeneration systems and Smart energy networks, "Power to X" and hydrogen technologies. Upon successful completion of the course, students will be able to: • Understand the theoretical background and technologies for the utilization of geothermal fields. • Know the processes of woody biomass utilization and the aspects of biofuel production (composting, gasification, transesterification, pyrolysis, anaerobic digestion). • Know the basic cogeneration technologies and can develop operating algorithms depending on the priorities of each project. • Prepare dimensioning and energy calculations for cogeneration systems and district heating - district cooling networks. • Analyze and implement strategies for the optimal use of smart grids to propose targeted energy solutions to consumers. • Become familiar with the technologies that convert energy into fuels or chemical products (Power to Gas, Power to Liquids, Power to Heat) and understand their techno-economic feasibility • Know the technologies for the production and use of hydrogen and understand their role in the energy economy.			
General Competences			

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

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new conditions
- Independent work & Teamwork
- Working in an international environment and interdisciplinary environment
- Generating new research ideas
- Project design and management
- Respect for diversity and interculturality
- Respect for the natural environment
- Demonstrating social, professional and ethical responsibility & sensitivity to gender issues
- Decision-making & Exercising criticism and self-criticism

Promoting free, creative and inductive thinking

3. SYLLABUS

In Geothermal energy, the topic is initially presented as a renewable energy source, and the available geothermal fields are distinguished, while the methodologies for exploration and assessment of geothermal potential are analyzed. Basic geological - geotechnical concepts are presented. The basic technologies for the exploitation of geothermal fields in the production of electrical and thermal energy are presented, as well as the design, siting and dimensioning methods

Regarding Biomass, the basic raw materials in the production of biomass and biofuels are presented (wood, by-products of agricultural crops, energy crops, urban or livestock organic waste, waste from the food industry). Biofuels are distinguished into solid, liquid and gaseous and their basic characteristics are presented (density, moisture content, net calorific value). The basic biofuel production processes are presented (composting, gasification, transesterification, pyrolysis, anaerobic digestion). Characteristic quantities of the biomass production process are given, regarding the required raw material and the production cost per unit of final product.

The basic alternative technologies for cogeneration of electricity and heat are presented, including thermoelectric plants, decentralized systems and trigeneration units. The concept of district heating and district cooling systems is given. Their basic components are presented, including networks, heat exchangers, alternative connectivity, etc. and typical examples of dimensioning and design of cogeneration and district air-conditioning systems are presented.

Furthermore, the course introduces the concepts of smart grids, presenting the conceptual model of smart grids and analyzing:

- the functionalities of smart grids
- the concept of demand management from the consumer's perspective and the available implementation strategies
- the implementation programs of smart grid processes
- the required technologies (telecommunications, electrical networks, demand management technologies and applications, decentralized energy production and storage devices)
- the expected benefits and difficulties of developing smart grids.

In addition, the technologies that convert electrical energy into other forms of energy or chemical products (Power-to-X) are presented, with emphasis on the production of hydrogen through electrolysis (Power-to-Gas), the conversion to liquid fuels (Power-to-Liquids) and the use for thermal energy (Power-to-Heat). In addition, examples are given for the idea of storing excess renewable electricity for future use, increasing the flexibility and sustainability of energy systems.

Finally, an introduction is made to the technologies for the production and use of hydrogen, as well as its integration into the energy economy. The role of hydrogen as a clean energy solution and the challenges facing its wider adoption are analyzed.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

Face-to-face, Distance learning, etc.

In person

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students		
TEACHING METHODS The manner and methods of teaching are described in detail.	Activity	Semester workload
	Course total	
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure		
5. ATTACHED BIBLIOGRAPHY		

DEPARTMENT OF MECHANICAL ENGINEERING, HELLENIC MEDITERRANEAN UNIVERSITY

