SOLAR ENERGY AND APPLICATIONS

COURSE OUTLINE

Responsible: Georgios Arnaoutakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.8.022.0	**SEMESTER**	2nd
COURSE TITLE	Solar Energy and Applications		

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) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

This course presents concepts and technologies related to the production of electrical and thermal energy through the utilization of solar radiation. For this purpose, the course is divided into three sections, a) Solar Geometry and the Properties of Solar Radiation, b) Solar Radiation Utilization Technologies for Direct Electricity Generation, and c) Solar Radiation Utilization Technologies for Direct Heat Generation.
After successful completion of the course, students will have:

- understood basic properties of solar radiation, calculating basic angles of solar geometry and solar potential
- understood the basic operation & energy production of photovoltaics from different absorber materials
- learned to calculate efficiency & energy production of different technologies and geometries of solar collectors
- learned to compose photovoltaic and solar thermal energy production systems with storage and their dimensioning
- performed measurements for the evaluation of photovoltaic and solar thermal systems

General Competences

- Search, analysis and synthesis of data and information, using necessary technologies
- Decision making
- Independent work
- Teamwork
- Working in an interdisciplinary environment

• Generation of new research ideas
• Promoting free, creative and inductive thinking

3. SYLLABUS

The course is divided into three sections:

a) Solar Geometry and the Properties of Solar Radiation. The first section presents and analyzes the basic concepts governing Solar Geometry, such as the basic angles that determine and characterize the sun's path on the horizon, such as solar declination, hour angle, sunrise and sunset time, solar altitude, solar azimuth, the concepts of solar and civil time, the surface azimuth and finally calculates the angle of incidence of solar radiation on a surface. The basic relationships that characterize the quantity and spectrum of solar radiation are also given, such as its three basic components (direct, diffuse and reflected) and empirical methods for estimating the available radiation at a geographical location and the radiation incident on a surface are presented.

b) Solar Radiation Utilization Technologies for Direct Electricity Generation. In the section on the production of electricity directly from solar radiation, the various photovoltaic system technologies are presented. The photoelectric and photovoltaic phenomenon is analyzed, basic technological concepts of electrical power generation from photovoltaic collectors are given, the basic layout-structure and the process of composition of a photovoltaic station are analyzed and the mathematical background is presented, with its numerical-computational application, for calculating the electrical power generation from photovoltaic panels.

c) Solar Radiation Utilization Technologies for Direct Heat Generation. In the section on heat generation from solar radiation, the various available solar collector technologies are given, such as open type, flat selective, vacuum tubes and parabolic mirrors, and their basic technical characteristics are presented. The analytical mathematical background for calculating the efficiency and heat generation from solar collectors and the numerical methodology for its application are also given. Indicative applications of the available solar collector technologies for hot water production, space heating, industrial uses and electrical power generation through solar thermal steam & gas turbine power plants are presented.

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	*The course is supported by computational tools and laboratory exercises on the above three distinct subjects.*
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