COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ECE_ENE820**	**SEMESTER**	**8**
COURSE TITLE	PHOTOVOLTAIC SYSTEMS AND APPLICATIONS		

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**
Lectures	3	
Seminars / Practice exercises	1	
Laboratory		
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	4	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	SPECIALISED , SKILLS DEVELOPMENT
PREREQUISITE COURSES:	No. Students should have FUNDAMENTAL KNOWLEDGE OF ELECTROTECHNIC MATERIALS
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.ece.uop.gr/

(2) 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*

The course aims to introduce both photovoltaic technology and the study of real problems encountered in the installation of photovoltaic systems. The high rates of factory production of photovoltaic panels on an international scale, as well as the increasing rates of their installation, strengthen the prospect of developing new activities in this sector. In this context, the course, which includes a theoretical and laboratory part, gives students the opportunity to be educated both on issues related to the materials used for the manufacture of photovoltaic cells and on issues related to the application of photovoltaic panels in autonomous and interconnected grids.

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
Adapting to new situations
Decision-making
Working independently
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues

Team work *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

Upon completion of the course, students will have: 1. The ability to recognize the need to use Renewable Energy Sources and their role in the energy requirements of Greece and the rest of the world. 2. The ability to analyze solar data from a specific location. 3. Ability to locate a photovoltaic system in an optimal way in a region. 4. Knows all the basic calculations for the presentation of a comprehensive application study of a PV system. 5. Uses tools to calculate expected electricity and to know its optimization methodologies and finally the ability to suggest the best technological solution for a specific case.

(3) SYLLABUS

The thematic units of the course are developed in thirteen weeks and contain the following:

Section 1: Solar radiation, electromagnetic radiation, basic theory and characteristic quantities of electromagnetic radiation, solar radiation and the effect of the Earth's atmosphere on its passing through, solar constants, their solar elements, direct, diffuse and reflected solar radiation, solar and spectral measurement instruments, motion of the earth around the sun, coordinates of the position of the sun in a observer's system, time of sunrise and sunset, duration of daily arc, daily energy gain from the sun, exploitation of solar radiation, possibility of utilization of photovoltaic energy, collector orientation and its determinants, timer setting, true solar time, equation.

Section 2: Contact of p and n semiconductors, diffusion, electric field in the contact area of two types, electrical behavior of p-n junction, characteristic current curve - voltage of a p - n junction, photovoltaic phenomenon, basic conditions for photoltaic electric phenomenon, equivalent illuminated photovoltaic circuit, characteristic current-voltage curve, maximum power point, photovoltaic filling factor, efficiency, photovoltaic silicon cells and other materials, thin coatings, organic photovoltaic cells.

Section 3: Effect of temperature on the electrical characteristics of the photovoltaic cell, ways of connecting photovoltaic cells, photovoltaic panels, nominal power, normal operating conditions, efficiency and factors that affect it, shading and fault problems, frame protection devices.

Section 4: Electricity storage and power management of photovoltaic systems, electric accumulators and their characteristics, lead and sulfuric acid accumulators, battery life time, determination of their battery life, capacity, battery life, capacity dependence , photovoltaic electronics, battery charge controller, DC - DC converters, DC - AC and AC to DC.

Section 5: Photovoltaic systems, features, categories and composition, autonomous systems, coverage of daily energy requirements, energy balance of daily produced - consumed energy, array efficiency, differential efficiency factor, photoenergy efficiency determination of autonomous energy system and cost autonomous photovoltaic system based on battery autonomy.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	View slides. View computer animations to describe the time evolution of photovoltaic phenomena. Demonstration of laboratory experiments at the time of teaching. Informational material to the eclass.

TEACHING METHODS

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

Activity	***Semester workload***
Lectures.	39
Problem solving.	13
Project	23
Study of literature and material exist to the eclass	50
Course Total	***125 hours (5 ECTS)***

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.

I. Written final examination (100%)

II. Optional written assignments (10%)

III. Optional problem solving (10%)

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. James P. Dunlop, Photovoltaic Systems, American Technical Publishers, Incorporated, 2012.
2. N.D. Kaushika, Anuradha Mishra, Anil K. Rai, Solar Photovoltaics: Technology, System Design, Reliability and Viability, Springer, 2018.
3. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications PHI Learning Pvt. Ltd., 2015
4. M. Buresch, Photovoltaic Energy Systems , McGraw-Hill, 2002
5. Kreith, F., Kreiderand, J.΄Solar Heating and Cooling΄, Hemisphere Publishing Corporation, 2000
6. In Greek: Ι. Φραγκιαδάκη, Φωτοβολταϊκά συστήματα. Εκδόσεις Ζήτη, 2006.