FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Fotowoltaika stosowana**
Name in English:	**Applied photovoltaics**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Industrial Electrical Engineering**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ELR051312**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30				
Number of hours of total student workload (CNPS):	60				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	2				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student should have basic knowledge of physics.
2. The student should be capable of implementing correctly and effectively the laws of physics to the qualitative analysis to problems related to the studied engineering discipline.
3. The student should understand the need for studying the selected discipline of study. The student should understand the need and be aware of the opportunities resulting from the continuous education. The student should understand the need for improvements of professional, personal and social skills

SUBJECT OBJECTIVES

C1. possess the knowledge of the photovoltaic effect and physical models of the photovoltaic cells;
C2. learn the fabrication methods of photovoltaic cells and photovoltaic modules as well as their basic characteristics and parameters.
C3. understand the methods of energy storage and energy conversion from photovoltaic systems.
C4. know the legal code concerning photovoltaics.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Have knowledge about the sun and its radiation and the photovoltaic effect and the structure and types of photovoltaic cells and have knowledge of the design and ways manufacture of photovoltaic modules and energy storage methods.

PEU_W02 Knows the methods testing, calibration and the proper selection of indicators of photovoltaic system elements and familiar with the legal conditions and standards in photovoltaic.

relating to skills:

relating to social competences:

PEU_K01 Ability to think and act creatively and resourcefully and be able to collaborate in a group and understanding the needs for following continuously the knowledge in the field of photovoltaics.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction of the subject, requirements and grading policy. Energy sources, the state of energy resources and their impact on the environment.	2
Lec 2	Basic concepts and units. Solar radiation and Earth's atmosphere.	2
Lec 3	Photovoltaic cells.	2
Lec 4	Description of the photovoltaic effect, current-voltage characteristics (I-V), Schottky barrier PV cells.	2
Lec 5	Technology and parameters of photovoltaic cells. Extraction, cleaning and crystal growth of silicon.	2
Lec 6	Crystalline photovoltaic cells. Polycrystalline thin-film photovoltaic cells. Cadmium tellurium photovoltaic cells. photovoltaic cells based on amorphous silicon.	2
Lec 7	Parameters and characteristics of the photovoltaic modules.	2
Lec 8	Influence of various factors on the efficiency of photovoltaic energy conversion. Construction of photovoltaic modules.	2
Lec 9	Stand-alone photovoltaic systems and photovoltaic systems integrated with a grid.	2
Lec 10	Photovoltaic systems integrated with buildings and following the sun.	2
Lec 11	Storage of electricity from photovoltaic modules, radiation concentrators. Standardization in photovoltaic power engineering.	2
Lec 12	Manufacturers of photovoltaic cells and modules. Testing and calibration of photovoltaic cells and modules.	2
Lec 13	Indicators of proper selection of elements for photovoltaic system. Development strategy for photovoltaic technology.	2
Lec 14	Final test.	2
Lec 15	Summary of lectures and perspective of development of photovoltaics. Discussion of results of the final test.	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Traditional lectures supplemented by audio-visual demonstrations. Multi-medial presentation. N2. Final test,

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_K01	Final test.
P(W)	P=F1	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] E. Klugman-Radziemska – Fotowoltaika w teorii i praktyce , Wydawnictwo BTC , Legionowo 2008. [2] M.T. Sarniak, Podstawy fotowoltaiki , Oficyna Wydawnicza Politechniki Warszawskiej, 2008. **SECONDARY LITERATURE:** [1] E. Klagmann, E. Klugman-Radziemska – Ogniwa i moduły fotowoltaiczne oraz inne niekonwencjonalne źródła energii, Fundacja Ekonomistów Środowiska i Zasobów Naturalnych, Białystok, 2005 [2] Z. Pluta – Słoneczne instalacje energetyczne, Oficyna Wydawnicza Politechniki Warszawskiej, 2008.

SUBJECT SUPERVISOR
Adam Gubański, adam.gubanski@pwr.edu.pl