

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Odnawialne źródła energii**  
 Name in English: **Renewable Energy Sources**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, part-time**  
 Kind of subject: **optional**  
 Subject code: **ELR051369**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	20				
Number of hours of total student workload (CNPS):	90				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	3				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10				

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge: 1. The student should have basic knowledge of physics. 2. The student should have basic knowledge about operation of power grids. 3. The student should know and understand the definitions of power quality parameters.
2. Skills: 1. The student should be capable correctly and effectively implement the rules and laws of physics to the qualitative analysis of problems related to the engineering discipline.  
Social Competence: 1. The student should understand the need for studying the selected discipline. 2. The student should understand the need and be aware of the opportunities resulting from the continuous education (II and III level studies, postgraduate studies, courses). 3. The student should understand the need for improvements of professional, personal and social skills.
- 3.

**SUBJECT OBJECTIVES**

- C1. Introduction to types and ranges of exploitation of renewable energy sources;  
 C2. Overview of exploitation possibilities and development options for renewable energy sources .  
 C3. Presentation of the electrical power production utilizing solar, wind, geothermal and biomass resources.  
 C4. Development of familiarity with the newest trends and solutions in energy generation from renewable energy sources.  
 C5. Making a student aware of the necessity of using renewable energy sources  
 C6. Explanation of the methods for connecting small energy sources to the grid.  
 C7. Familiarization with the effect of small energy sources on grid performance.

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 have knowledge concerning types and utilization range of renewable energy sources in the aspect of solar energy, of wind energy, of geothermal and biomass energy ;  
 PEU\_W02 be able to identify and characterize the methods of energy production in fuel cells or from nuclear energy sources and in magneto-hydrodynamic and be able to list and describe existing energy sources and explain the conversion of this energy to electricity and identify and explain the methods of electricity storage in super capacitors and expose the contradiction between existence of perpetual motion machines with the laws of physics.  
 PEU\_W03 know how to connect small energy sources to the grid and understand their impact on the grid operation.

*relating to skills:**relating to social competences:*

- PEU\_K01 ability to think and act creatively and resourcefully and be aware of the necessity to develop renewable energy sources.

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Introduction of the subject, requirements and grading policy. Types and utilization range of the renewable energy sources. Development perspectives for renewable energy sources in Poland and in the world. Geothermal resources in Poland and in the world. Geothermal installations in Poland. Operation principles and construction of heat pumps. Biomass. Characterization of selected biofuels. Biogas and its origin. Heat and electricity production from biogas fuels.	2
Lec 2	Utilization of solar energy for production of both electricity and thermal energy. Characteristics of the solar radiation spectrum. Photovoltaic effect. Photovoltaic cells. Construction of photovoltaic panels and modules. Construction of photovoltaic systems.	2
Lec 3	Utilization of wind energy for electricity production. Characteristics of the wind and its energy reserve. Operation and construction of wind farms. Wind mills and their characteristics.	2
Lec 4	Fuel cells. Basic electrochemistry. Construction, principles of operation and types of fuel cells. Application examples. Methods of hydrogen production. Alternative elements for fuel cells.	2
Lec 5	Utilization of energy from the surrounding – energy scavengers. Functional energy resources and associated physical effects. Operation principles, construction and types of energy scavengers. Application examples.	2
Lec 6	Super-capacitors as the energy storage devices. Operation principles, construction and types of super-capacitors. Combined systems of super-capacitors and photovoltaic panels. Magnetohydrodynamic generators.	2
Lec 7	Connection of small energy sources to an electrical grid. Impact of small energy sources on the operation conditions of the grid.	2
Lec 8	Characteristics of small energy sources containing synchronous and asynchronous generator connected directly to the grid.	2
Lec 9	Characteristics of small energy sources connected to the grid through electrical convertors.	2
Lec 10	Final Test	2
Total hours:		<b>20</b>

## TEACHING TOOLS USED

- N1. Traditional lectures supplemented by audio-visual demonstrations. Multi-medial presentation.  
 N2. Class presentations of physical effects, operation of devices and installations, demonstrations, etc.  
 N3. Conceptual discussions.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Final test
P(w)	P=F1	

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [1] Praca zbiorowa: Energia ze źródeł przyjaznych środowisku : zagadnienia wybrane, Gdańsk : Wydawnictwo Instytutu Maszyn Przepływowych, 2001.  
 [2] Praca zbiorowa: Niekonwencjonalne źródła energii , Wrocław : Wydawnictwo Akademii Rolniczej, 1999.  
 [3] Tytko S.: Odnawialne źródła energii, OWG Warszawa, 2010.  
 [4] Lewandowski W.M.: Proekologiczne odnawialne źródła energii, Wydawnictwa Naukowo-Techniczne, Warszawa 2006.  
 [5] Kacejko P.: Generacja rozproszona w systemie elektroenergetycznym. Wydawnictwo Uczelniane. Politechnika Lubelska 2004.  
 [6] Lubośny Z.: Elektrownie wiatrowe w systemie elektroenergetycznym. WNT warszawa 2006.

### SECONDARY LITERATURE:

- [1] Da Rosa, Aldo Vieira, Fundamentals of renewable energy processes, Amsterdam: Elsevier Academic Press, cop. 2005  
 [2] Jenkins N., Allan R., Crossley P., Kirschen D., Strbac G.: Embeded Generation. Power & Energy 2000.

## SUBJECT SUPERVISOR

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