FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish	**Systemy Konwersji Enrgii Słonecznej**
Name of subject in English	**Solar Energy Conversion Systems**
Main field of study (if applicable):	**Energetyka / Power engineering**
Specialization (if applicable):	**Renewable Sources of Energy**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code	**W09ENG-SM0047W**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		30	60	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points					
including number of ECTS points for practical classes (P)	2		1	2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1		0,75	1,75	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Technical Thermodynamics
2. Fluid Mechanics.

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SUBJECT OBJECTIVES

C1. Acquisition of practical knowledge, regarding solar energy conversion systems, their design and application.
C2. Development of skills how to design, measure and analyze solar energy conversion systems

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 – has knowledge of rules and standards for design and operation of solar energy conversion systems

PEK_W02 - have knowledge of the design of solar energy conversion installations

relating to skills:

PEU_U01 - can determine the basic parameters of the solar collector and photovoltaic panel.

PEK_U02 - can conclude from the measurements of solar energy conversion systems operating parameters

PEU_U03 - can calculate parameters related to solar radiation

PEU_U04 - can design a liquid-based or air-based solar collector

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Overview of the lecture. Introduction. History of solar energy.	2
Lec 2	The energy potential of the sun. Classification and types of radiation.	2
Lec 3	The laws of radiation. Calculations of basic parameters.	2
Lec 4	Classification and division of solar energy conversion systems.	2
Lec 5	Solar energy collectors. Stationary and sun-tracking collectors. Flat-plate, evacuated tube and concentrating collectors.	2
Lec 6	Selection of construction materials for solar collectors.	2
Lec 7	Thermal analysis of solar collectors. Possibilities of improving the efficiency of solar radiation processing.	2
Lec 8	Photo-optics of concentrating collectors. Design of tracking systems.	2
Lec 9	Thermal performance of solar collectors. Thermal efficiency, heat capacity of a collector.	2
Lec 10	Theory of the photoelectric effect. Possibilities of converting solar radiation into electricity.	2
Lec 11	PV cell characteristics. Types of PV technology. Related equipment (batteries, charge controllers, inverters, peak-power trackers).	2
Lec 12	Solar-thermal energy conversion system. Power tower systems (sun-tracking mirrors, tall tower receiver, working fluids).	2
Lec 13	Low-temperature heat applications - energy balance, domestic water heating, heat storage.	2
Lec 14	Solar desalination systems. Direct and indirect systems. Desalination Plants.	2
Lec 15	Colloquium.	2
	Total hours	30
Laboratory		**Number of hours**
Lab 1	Thermodynamic changes of moist air inside the air-based solar collector.	2
Lab 2	Determination of thermal efficiency of the air-based solar collector.	2
Lab 3	Measurements of working parameters of the liquid-based solar collector.	2
Lab 4	Determination of thermal efficiency of the liquid-based solar collector.	2
Lab 5	Measurements of working parameters of the evacuated tube solar collector.	2
Lab 6	Measurements of working parameters of the PV panel.	2
Lab 7	Determination of energy efficiency of the PV panel.	2
Lab 8	Corrective and supplementary classes	1
	Total hours	15
Project		**Number of hours**
Proj 1	Overview and introduction to the project. Distribution of the individual data for the project.	2

Proj 2	Determining the useful time of the designed solar collector for individual design tasks. Calculating of solar radiation value in the assumed period of use of the collector for individual design tasks.	2
Proj 3	Selection of construction materials for the solar collector.	2
Proj 4	Selection of transparent cover for the designed collector. Calculations and selection of collector insulation.	2
Proj 5	Determination of thermal losses of a solar collector. Calculation of the heat power generated by the designed panel.	2
Proj 6	Selection of additional components.	2
Proj 7	Individual consultations.	2
Proj 8	Submission of completed projects.	1
	Total hours	15

TEACHING TOOLS USED

N1. Traditional lecture with presentation of slides.
N2. Laboratory – discussion of problems
N3. Self-study – reading of supplementary materials.
N4. Self-study – working on the individual project.
N5. Self-study – study and preparation to the exam.
N6. Consultation – improvement of knowledge

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	PEU_W01 – PEU_W02	Mark of the colloquium
P2	PEU_U01 – PEU_U02	Reports from laboratory classes
P3	PEU_U03 – PEU_U04	Mark of submitted project

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 2016 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Applications (SI Edition), © 2016 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
[2] Kreider J. F., 1982. The Solar Heating Design Process. McGraw-Hill, New York
[3] Hsieh J. S., 1986. Solar Energy Engineering. Prentice-Hall, Englewood Cliffs, NJ

SECONDARY LITERATURE:

[1] Duffie J. A., Beckman W. A., 2006. Solar Engineering of Thermal Processes, third ed. Wiley & Sons, New York
[2] Norton B., 1992. Solar Energy Thermal Technology. Springer-Verlag, London

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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