Solar energy conversion system

Faculty of	**Mechanical and Power Engineering**
Name in English	**Solar energy conversion system**
Name in Polish	**Systemy Konwersji Enrgii Słonecznej**
Main field of study	**Power Engineering**
Specialization	**-**
Level of studies	**II level**
Form of studies	**full-time**
Kind of subject	**optional-specialization**
Subject code	**W09ENG-SM2352**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15	15	
Number of hours of total student workload (CNPS)	50		25	50	
Form of crediting	Exam		Crediting with grade	Crediting with grade	
For group of courses mark final course with (X)					
Number of ECTS points	2		1	2	
including number of ECTS points for practical (P) classes			1	2	
including number of ECTS points for direct teacher-student contact (BU) classes	0,84		0,76	0,76	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.	Technical Thermodynamics
2.	Fluid Mechanics

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 LEARNING OUTCOMES

relating to knowledge:	
PEU_W01	Has knowledge of rules and standards for design and operation of solar energy conversion systems
PEU_W02	Has 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.
PEU_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 collecto.r

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec1	Overview of the lecture. Introduction. History of solar energy	1
Lec 2 – Lec8	The energy potential of the sun. Classification and types of radiation. The laws of radiation. Classification and division of solar energy conversion systems. Solar energy collectors. Stationary and sun-tracking collectors. Flat-plate, evacuated tube and concentrating collectors. Selection of construction materials for solar collectors. Thermal performance of solar collectors, efficiency, heat capacity of a collector. Theory of the photoelectric effect. Possibilities of converting solar radiation into electricity. PV cell characteristics. Types of PV technology. Related equipment (batteries, charge controllers, inverters, peak-power trackers). Low-temperature heat applications.	14
Total hours		15

laboratory		Number of hours
La1 – La7	Thermodynamic changes of moist air inside the air-based solar collector. Determination of thermal efficiency of the air-based solar collector. Measurements of working parameters of the liquid-based solar collector. Determination of thermal efficiency of the liquid-based solar collector. Measurements of working parameters of the evacuated tube solar collector. Measurements of working parameters of the PV panel. Determination of energy efficiency of the PV panel.	14
La8	Corrective and supplementary classes	1
Total hours		15

project		Number of hours
Pr1	Overview and introduction to the project. Distribution of the individual data for the project.	1
Pr2 – Pr8	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. Selection of construction materials for the solar collector. Selection of transparent cover for the designed collector. Calculations and selection of collector insulation. Determination of thermal losses of a solar collector. Calculation of the heat power generated by the designed panel. Selection of additional components. Individual consultations. Submission of completed projects.	14
Total hours		15

TEACHING TOOLS USED	
N1	Traditional lecture with presentation of slides.
N2	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 EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F– forming (during semester), C– concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
C1	PEU_W01 – PEU_W02	Exam
C2	PEU_U01 – PEU_U02	Reports from laboratory classes
C3	PEU_U03 – PEU_U04	Mark of submitted project

PRIMARY AND SECONDARY LITERATURE

Primary literature	
1	[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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