COURSE DESCRIPTION CARD - SYLLABUS

Course name
Photovoltaic systems [S1Energ1>SF]

Course

Field of study
Power Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of renewable and unconventional energy sources. The ability to effectively self-educate in a field related to the chosen field of study. Awareness of the need to expand one"s competences, readiness to cooperate within the team.

Course objective

Expanding knowledge related to the construction, parameters, principles of operation and application possibilities of solar cells. Presentation of technological issues and their impact on the application possibilities and operational parameters of solar cells. Acquainting students with the problems of photovoltaic solutions, e.g. in construction, vehicles, stand alone. Characteristics of photovoltaic installations (autonomous, network-connected, hybrid), installation components. Presentation of standardization, legal, economic and recycling issues.

Course-related learning outcomes

Knowledge:
the student has basic knowledge of solar cells (construction, technology and application possibilities. he knows and understands the phenomena, processes and operation of devices that convert the sun"s

energy into electricity. he is familiar with the current state and the latest development trends in poland and in the world. methods of measurement and analysis of results of quantities influencing the value of electricity production knows the rules of assembly, operation and disassembly of photovoltaic installations.

Skills:
the student is able to obtain and practically use information from the literature on the subject, databases, technical documentation, operational recommendations and other sources. can work independently and in a team. he can use properly selected methods and devices that enable measurement of basic quantities characterizing elements and systems.

Social competences:
the student is aware that the knowledge and skills in the field of renewable energy sources are important in the implementation of sustainable energy development in accordance with national and eu development plans. the student understands that the knowledge and skills in the field of the subject require continuous improvement and updating with newer and newer technological solutions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge acquired during the course is verified during the exam. The exam consists of 15 test questions and 5 open-ended questions with different scores. The pass mark is 50% of the total number of points.
The skills acquired during the laboratory classes are verified on the basis of reports and grades obtained by students during individual classes through activity.

Programme content

Lecture:
- solar radiation energy (radiation components, models and mathematical relationships),
- discussion of the optimization of spatial orientation of the solar energy receiver in terms of energy gain,
- conversion of solar energy into electricity, replacement scheme of a solar cell,
- cell parameters and characteristics, fill factor, PMM,
- material, construction and operational solutions of solar cells (selected properties),
- devices included in the PV installation: modules, inverters, batteries, charging regulators, trackers, monitoring systems, wiring, supporting structure
- Recycling normalization. Assembly. Operation and maintenance of PV installations,

Lab:
- the impact of the spatial location of photovoltaic modules on their operational parameters,
- the influence of the wavelength of the radiation spectrum on the electrical parameters of photovoltaic cells,
- current and voltage mismatch of photovoltaic modules,
- cooperation of photovoltaic modules with energy storage.

Teaching methods

Lecture: multimedia presentation (including drawings, photos, animations, sound, films) supported by examples given on the blackboard.
Laboratory: use of the available laboratory facilities and specially prepared test stands.

Bibliography

Basic
Jastrzębska G.: Ogniwa słoneczne Budowa, technologia, zastosowanie. WKŁ Warszawa 2013.
Jastrzębska G. :Energia ze źródeł odnawilnych i jej wykorzystanie. WKŁ, Warszawa 2017.
Góralczyk I., Tytko R. : Fotowoltaika . Urządzenia instalacje fotowoltaiczne i elektryczne. Towarzystwo Słowaków w Polsce 2015.
Sibiński K., Znajdek K.:Przyrządy i instalacje fotowoltaiczne PWN Warszawa 2017.
Pluta Z.: Podstawy teoretyczne fototermicznej konwersji energii słonecznej Oficyna Wydawnicza

Politechniki Warszawskiej, 2013.
Additional
Wacławek M., Rodziewicz T.: Ogniwa słoneczne. Wpływ środowiska naturalnego na ich pracę.WNT, Warszawa 2011.
Jastrzębska G.: Akumulator jako źródło energii w Poradniku Montera Elektryka, PWN, Warszawa 2016.
Luque A., Hegedius S.: Handbook of Photovoltaic Science and Engineering, John Wiley&Sons, England 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,00
Classes requiring direct contact with the teacher	51	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	39	1,00