POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Renewable energy sources [S2Eltech1E>OZE]

Course

Field of study
Electrical Engineering

Year/Semester
1/1

Area of study (specialization)
Electrical Systems in Industry and Vehicles

Profile of study
general academic

Level of study
second-cycle

Course offered in
english

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

4,00

Coordinators

dr inż. Grzegorz Trzmiel
grzegorz.trzmiel@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of physics, electrical engineering and mathematics (general level). The ability to understand and interpret the knowledge passed on during classes. 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 as part of the team.

Course objective

To acquaint students with the structure, principle of operation, possibilities and principles of designing systems using renewable energy sources, in particular in the field of: photovoltaics, wind energy, electricity storage and hybrid systems. Presentation of new possibilities in the field of obtaining electricity using the above-mentioned technologies.

Course-related learning outcomes

Knowledge:
1.has an orderly and theoretically founded knowledge in the field of renewable energy sources,
2. knows and understands the phenomena and processes that allow the conversion of energy from selected renewable energy sources into electricity,

3. is aware of the current state of development of renewable energy sources and prospective trends in Poland and in the world.

Skills:
1.can obtain information from literature, databases and other sources, analyze and interpret it, draw conclusions, justify opinions,
2.can work independently and in a team, use properly selected methods and devices in terms of electrical parameters and characteristics,
3. is able to carry out the necessary design calculations, interpret the obtained results, draw conclusions.

Social competences:
1.can work individually and cooperate in a group,
2. is aware of the importance and understanding of non-technical aspects and effects of engineering activities, including its impact on the environment and the responsibility for the decisions made.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the course of the lecture is verified by completing the course lasting approx. 45-60 minutes, consisting of 10-15 questions (test and open), with different scores. Passing threshold: 50% of points. The issues on the basis of which the questions are developed will be sent to students by e-mail using the university's e-mail system.
The skills acquired during the laboratory classes are verified on the basis of: grades from reports on the exercises performed. In addition, the final assessment of laboratories takes into account: rewarding the knowledge necessary to implement the problems posed in a given area of laboratory tasks, activity in each class, rewarding the increase in the ability to use the learned principles and methods, assessment of knowledge and skills related to the implementation of the exercise task.
Design classes are assessed on the basis of activities during design classes and the completed project in accordance with the requirements specified by the teacher.
In addition, the student can earn additional points for activity during classes, and especially for: proposing to discuss additional aspects of the issue, the effectiveness of applying the acquired knowledge when solving a given problem, the ability to cooperate as part of a team practically implementing a detailed task in the laboratory and in a project task, comments related to improvement didactic materials, aesthetic diligence of the tasks developed as part of self-study.

Programme content

Lectures:
Legal conditions for the use of renewable energy sources. Characteristics of selected renewable energy sources and devices enabling conversion and storage of energy from renewable sources, mainly in terms of prosumer: photovoltaics (PV), wind energy (TW), electricity storage, hybrid systems. Costs of generation, transmission and distribution of electricity. Estimating energy yields. Statistical description of wind and solar energy. Analytical and numerical modeling of wind turbines and PV modules (Weibull decomposition, wind turbine power characteristics, single-diode and two-diode photo cell model, MPP tracker simulation). Types and use of measurement data of wind speed and irradiance in estimating energy obtained from wind turbines and PV panels. Time series analysis. Application possibilities in various fields. Advantages, disadvantages, limitations of various system solutions. Presenting innovative solutions in the field of the subject, used in the latest practical solutions.
Laboratories:
Getting to know the construction, principle of operation and operating characteristics of various types of photovoltaic modules, wind turbines and hybrid systems in various configurations and operating conditions. Planning the measurement methodology, measurements and calculations of the characteristic parameters of the above-mentioned devices.
Projects:
Presentation of the methodology of designing systems: PV, TW and hybrid systems, including those with energy storage and heat pumps in prosumer installations. Calculation of the necessary parameters in the design and selection of devices. Verification and consultation of projects carried out by students. Analysis of the energy efficiency of systems designed in such a way, taking into account their mutual comparison with qualitative and quantitative inference.

Teaching methods

Lecture: multimedia presentations containing drawings, diagrams, photos, supplemented with practical examples on the blackboard, slides and computer programs, which makes it easier to combine theory with practice. The lecture is supplemented with additional materials to be provided to students for independent study. Using students' knowledge of other subjects, initiating discussions, asking questions to increase student activity and independence.
Laboratories: team work (measurements) on physical positions modeling the work of renewable energy sources in the field of photovoltaics, wind energy, hybrid systems in cooperation with e.g. energy storage and charging regulators.
Projects: multimedia presentations and blackboard classes containing the necessary elements (drawings, charts, diagrams, patterns) in the process of designing renewable energy installations with PV, TW, energy storage and heat pumps. The use of dedicated software in the calculation and verification process.
Ongoing verification during classes of students' progress in terms of prepared projects, with comments enabling proper management of the course of work.

Bibliography

Basic:
1. Jastrzębska G., Ogniwa słoneczne. Budowa, technologia i zastosowanie, Wydawnictwa Komunikacji i Łączności, Warszawa, 2013.
2. Wolańczyk F., Elektrownie wiatrowe, Wydawnictwo KaBe, Krosno, 2009.
3. Lewandowski W.: Proekologiczne źródła energii odnawialnej, WNT, Warszawa 2012.
4. Corkish R., Sproul A., and others, Applied Photovoltaics, 3rd Edition , Taylor&Francis eBooks, 2013.
5. Haberlin H, Photovoltaics system design and practice, Wiley, 2013.
6. Jenkins D., Renewable Energy Systems, Earthscan Expert, 2013.
7. White S., Solar Photovoltaic Basics, Taylor&Francis Ltd, 2015.

Additional:
1. Paska J., Wytwarzanie energii elektrycznej, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.
2. Lubośny Z, Farmy wiatrowe w systemie elektroenergetycznym, Wydawnictwo WNT, Warszawa, 2013.
3. Kasprzyk L., Tomczewski A., Pietracho R., Mielcarek A., Nadolny Z., Tomczewski K., Trzmiel G., Alemany J., Optimization of a PV-Wind Hybrid Power Supply Structure with Electrochemical Storage Intended for Supplying a Load with Known Characteristics, Energies, vol. 13(22), 6143, 2020, https://doi.org/10.3390/en13226143
4. Głuchy D., Kurz D., Trzmiel G., The impact of shading on the exploitation of photovoltaic installations, Renewable Energy, vol. 153, p. 480-498, June 2020, DOI: https://doi.org/10.1016/j.renene.2020.02.010.
5. Trzmiel G., Analiza metod regulacji mocy w elektrowniach wiatrowych, Computer applications in electrical engineering vol. 89/2017, Poznan University of Technology Academic Journals Electrical Engineering, Poznań, 2017, str. 395-404.
6. Trzmiel G., Układy śledzące punkt maksymalnej mocy w inwerterach stosowanych w instalacjach fotowoltaicznych, Computer applications in electrical engineering vol. 87/2016, Poznan University of Technology Academic Journals - Electrical Engineering, Poznań, 2016, str. 23 - 36.
7. Trzmiel, G., Jajczyk, J., Kardas-Cinal, E., Chamier-Gliszczynski, N., Wozniak, W., Lewczuk, K. (2021). The
Condition of Photovoltaic Modules under Random Operation Parameters. Energies, vol. 14(24), 8358, 2021.
8. Internet: specjalistyczna literatura tematu, karty katalogowe, normy.

Breakdown of average student's workload

	Hours	ECTS
Total workload	110	4,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50