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	Year/Semester
Electrical Engineering	1/1
Area of study (specialization)	**Profile of study**
Drive Systems in Industry and Electromobility	general academic
Level of study	**Course offered in**
second-cycle	English
Form of study	**Requirements**
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other
15	15	0
Tutorials	**Projects/seminars**	
0	15	

Number of credit points

4,00

Coordinators

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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

The module program covers issues related to the construction, principles of operation, cooperation and use of devices generating and storing energy using renewable energy sources. and the basis for calculating the economic profitability of using renewable energy sources.

Course topics

The lecture program covers the following topics:
Legal conditions for the use of renewable energy sources. Characteristics of selected renewable energy sources and devices enabling the conversion and storage of energy from RES, mainly from the prosumer perspective: photovoltaics (PV), wind energy (TW), electricity storage, hybrid systems. Costs of generation, transmission and distribution of electricity. Estimation of energy yields and investment payback time. Statistical description of wind and solar energy. Analytical and numerical modeling of wind turbines and PV modules (Weibull distribution, power characteristics of wind turbines, single-diode and two-diode photovoltaic models, MPP tracker simulation). Types and use of wind speed and irradiance measurement data in estimating energy obtained from wind turbines and PV modules. 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.
The laboratory program covers the following topics:
Getting to know the structure, principle of operation and operating characteristics of various types of photovoltaic modules, wind turbines and hybrid systems in various configurations and operating conditions. Planning measurement methodology, measurements and calculations of characteristic parameters of the above-mentioned devices.
The project class program covers the following topics:

The classes concern the development of a project of a hybrid on-grid generation system using PV modules and wind turbines. The details of the tasks carried out concern:
- analysis of design assumptions and determination of the overall structure of the system
- analysis of energy resources at the location of the generation system and determination of its power
- equipment selection (PV modules, turbines, inverters, optimizer systems, protections, cables, lightning and surge protection, monitoring)
- economic analysis and determination of the investment payback period
- development of design documentation, including the installation location of PV modules and wind turbines
- use of software intended for analysis and design of renewable energy generation systems.

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. Yang P., Renewable Energy: Challenges and Solutions, Springer, 2024.
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:
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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
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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.
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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