COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of hydrogen energy [S2Elenerg1>PEW]

Course

Field of study
Electrical Power Engineering

Year/Semester
2/3

Area of study (specialization)
Smart Grids

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Student knows the structure and principle of operation of hydrogen fuel cells and electrolysers. Student knows the basic quantities describing the operation of these devices.

Course objective

Acquiring the ability to carry out energy analyzes of the operation of distributed generation systems with energy storage in the form of hydrogen. Getting to know the methods of risk control related to work on hydrogen installations.

Course-related learning outcomes

Knowledge:
student has knowledge of the possibilities of using hydrogen in the power industry as an energy carrier and as a fuel.
student has knowledge of the risks associated with the use of hydrogen and ways to reduce them.

Skills:
student is able to carry out a technical and economic analysis of the operation of the res-electrolyser-

fuel cell system.
student can indicate the benefits of the development of hydrogen energy.

Social competences:
student knows and understands the need to develop the hydrogen energy sector.
student understands the need for actions to make the society aware of the ways of eliminating the risks associated with working with hydrogen installations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture
- evaluation of the knowledge and skills listed on the written exam,
Projects
- assessment of knowledge and skills related to the implementation of the project task, assessment of the completed project.

Programme content

Lecture
Basic problems of hydrogen energy. Physico-chemical properties of hydrogen. Hydrogen as fuel. Health and safety on hydrogen installations. Operation characteristics of electrolysers. Performance characteristics of PEM fuel cells. Energy analyzes of hybrid generation systems with energy storage in the form of hydrogen. Energy analyzes of the operation of a stack of fuel cells with an ion-exchange polymer membrane.
Projects
Design task related to the technical and economic analysis and feasibility study of the "renewable source - electrolyser" system or "hybrid power generation system with hydrogen fuel cell".

Teaching methods

Lecture:
Lecture with multimedia presentation supplemented with examples given on the board.
Projects:
Independent solution of a design problem in the field of technical and economic analysis of a system for the production of green hydrogen.

Bibliography

Basic
Chmielniak Tadeusz, Chmielniak Tomasz, Energetyka wodorowa. Warszawa 2020.
Surygała Jan. Wodór jako paliwo, WNT 2008
Additional
Ogulewicz W., Węcel D., Wiciak G., Łukowicz H., Kotowicz J., Chmielniak T., Pozyskiwanie energii z ogniw paliwowych typu PEM chłodzonych cieczą, Gliwice 2010.
Chmielniak T., Lepszy S., Mońka P., Energetyka wodorowa - podstawowe problemy, POLITYKA ENERGETYCZNA – ENERGY POLICY JOURNAL, Tom 20, Zeszyt 3, 55–66, ISSN 1429-6675, 2017
Ceran B., Orłowska A., Krochmalny K., The method of determining PEMFC fuel cell stack performance decrease rate based on the voltage-current characteristic shift. Eksploatacja i Niezawodność – Maintenance and Reliability - 2020, vol. 22, no. 3, s. 530-535
Ceran B., Multi-Criteria Comparative Analysis of Clean Hydrogen Production Scenarios. Energies - 2020, vol. 13, no. 16, s. 4180-1-4180-21
Ceran B., Szczerbowski R., Energy cost analysis by hybrid power generation system. IOP Conference Series: Earth and Environmental Science - 2019, vol. 214, s. 012001-1-012001-8
Ceran B. Bezpieczeństwo użytkowania instalacji wodorowych, Przegląd Naukowo-Metodyczny, Edukacja dla Bezpieczeństwa - 2014, nr 3(24), s. 680-691

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00