

Course title: <b>Fuel cells and hydrogen technology</b> Ogniwa paliwowe i technologie wodorowe		
Field of study:		
Type of study: <b>full-time studies</b>	The level of education: <b>first-cycle studies</b>	Education profile: <b>general academic</b>
Type of subject: Wybierz element.	Semester: Wybierz element.	Course language: <b>English</b>
Course type: <b>lecture, tutorial</b>	Number of hours: <b>15L, 15T</b>	ECTS Credit points: <b>5</b>

## SYLLABUS

### COURSE CONTENT

Form of classes - lectures	Hours
The origins of the development of fuel cells. Fuel cell efficiency.	2
The construction of fuel cells, the functions of the individual elements of the fuel cell. Selection of materials for electrodes, catalysts, membranes. Principle of operation of fuel cell type PEMFC, electrochemical reactions occurring in cells.	3
Classification and types of fuel cells.	2
Auxiliaries necessary for the operation of the fuel cell. Fuel cells as generators of heat and electricity in residential buildings.	2
Properties of hydrogen, hydrogen as an energy carrier. Methods of hydrogen production. Storage of hydrogen (types of alloy, cylinder) and distribution of hydrogen.	2
Hybrid fuel cell hybrid systems.	2
Economic analysis of the fuel cell system. Test.	2
Form of classes - tutorials	Hours
Chemical reactions in cells of different types and electrolysis. Methods for determining the efficiency of fuel cells. Performance characteristics of fuel cells.	3
Carbon materials used to build cell elements.	3
Porous Foaming Electrodes. Types of materials used to store hydrogen. Types of electrochemical catalysts used in low temperature cells.	2
Methods of selection of materials for electrodes and membranes - measurement methods, types of measuring instruments (porosity, humidity, structure).	2
Methods of selection of materials for mono / bipolar coverings - measurement methods, types of measuring instruments (corrosion resistance, porosity, roughness, wettability, microstructure, inter-surface resistance).	2
The world's fuel cell market.	2
Test	1

### COURSE STUDY METHODS

1. blackboard
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2. multimedia presentation

**METHODS OF ASSESMENT ( F - formative; S - summative)**

<b>F1.</b> - activity in classes
<b>F2.</b> - evaluation of task solving
<b>S1.</b> – test
<b>S2.</b> - seminary/presentation

**STUDENT WORKLOAD**

<b>Form of activity</b>	<b>Workload (hours)</b>
Participation in lectures	15 h
Participation in classes	-
Laboratory	-
Participation in project classes	-
Participation in seminar	15h
Preparation course on e-learning	-
Test	5 h
Entrance test for laboratory classes	-
Project's defence	-
Exam	-
Consultation hours	2 h
<b>DIRECT TEACHING, hours/ ECTS</b>	<b>37 h / 3 ECTS</b>
Preparation for tutorials	15 h
Preparation for laboratories	-
Preparation for projects	-
Preparation for seminars	5 h
Preparation for e-learning classes	-
Participation in e-learning classes	-
Working on project	-
Preparation for tests	-
Preparation for exam	-
<b>SELF-STUDY, hours/ ECTS</b>	<b>20 h / 2 ECTS</b>
<b>TOTAL (hours)</b>	<b>∑ 57</b>
<b>TOTAL ECTS</b>	<b>5 ECTS</b>

**PRIMARY AND SUPPLEMENTARY TEXTBOOKS**

Fuel Cell Handbook, Sixth edition, EG&G Technical Services, Inc. Science Applications International Corporation, DOE/NETL- 2002/1179
J. Larminie, A. Dicks: Fuel cell system explained, Wiley, New York 2000.
Chmielniak T. Technologie energetyczne, Wydawnictwa Naukowo-Techniczne, Warszawa 2008.

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