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

# **SYLLABUS**

# **COURSE CONTENT**

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

# COURSE STUDY METHODS

1. blackboard

## 2. multimedia presentation

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

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

#### STUDENT WORKLOAD

Form of activity	Workload (hours)
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>	37 h / 3 ECTS
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	-
SELF-STUDY, hours/ ECTS	20 h / 2 ECTS
TOTAL (hours)	$\Sigma$ 57
TOTAL ECTS	5 ECTS

### PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Fuel Cell Handbook, Sixth edition, EG&G Technical Services, Inc. Science Applications International Corporation, DOE/NETL- 2002/1179

J. Larmine, A. Dicks: Fuel cell system explained, Wiley, New York 2000.

Chmielniak T. Technologie energetyczne, Wydawnictwa Naukowo-Techniczne, Warszawa 2008.

# SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Renata Włodarczyk, renata.wlodarczyk@pcz.pl

# NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Renata Włodarczyk, renata.wlodarczyk@pcz.pl