



## Subject card

Subject name and code	Fuel cells and high temperature electrolysers, PG_00058357						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2022	Academic year of realisation of subject				2024/2025	
Education level	first-cycle studies	Subject group				Obligatory subject group in the field of study Subject group related to scientific research in the field of study	
Mode of study	Full-time studies	Mode of delivery				at the university	
Year of study	3	Language of instruction				Polish	
Semester of study	5	ECTS credits				3.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Katedra Inżynierii Materiałów Funkcjonalnych WET1 -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Piotr Jasiński					
	Teachers	prof. dr hab. inż. Piotr Jasiński Omid Ekhlasiogouei					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours		Self-study	SUM	
	Number of study hours	45	6.0		24.0	75	
Subject objectives	The aim of the course is to learn about the mechanisms of operation, design and materials used in the construction of high-temperature fuel cells and electrolysers						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W18] knows the basics of the construction and operation of high-temperature fuel cells and electrolysers powered by hydrogen and other fuels and their practical application for energy generation and storage	The student knows the principles of construction and operation of high temperature fuel cells (SOFC) and electrolysers (SOEC), including the mechanisms of energy conversion and the chemical reactions occurring in these devices.			[SW1] Assessment of factual knowledge		
	[K6_U01] Is able to obtain information from literature, databases and other sources, integrate them, interpret them and draw conclusions and formulate opinions; has the ability to self-educate m.in. in order to improve professional competences	The student is able to obtain information effectively from a variety of sources such as literature, databases and other available materials on topics related to high-temperature fuel cells and electrolysers			[SU1] Assessment of task fulfilment		
Subject contents	Fundamentals of fuel cells and electrolysers. The role of fuel cells and electrolysers in energy systems. Applications of high temperature fuel cells (SOFC) and electrolysers (SOEC). Mechanism of conversion of chemical energy of fuel into electrical energy. Structure and materials used in SOFCs: electrodes, electrolytes, interconnectors. Chemical reactions occurring in SOFCs: hydrogen oxidation, oxygen reduction. Principle of operation and differences between SOFC and SOEC. High temperature water electrolysis process: hydrogen production. Materials used in SOEC and their characteristics. Production methods for fuel cells and electrolysers. Technological problems and challenges of high temperature fuel cells and electrolysers. Energy efficiency and performance. Durability and stability of operation at high temperatures. Technical issues such as material degradation and corrosion. Industrial and domestic applications of SOFCs: micro-cogeneration, backup power. Examples of practical SOFC and SOEC implementations.						
Prerequisites and co-requisites							

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lab	50.0%	40.0%
	Lecture - test	50.0%	60.0%
Recommended reading	Basic literature	<p>SINGHAL, Subhash C.; KENDALL, Kevin (ed.). <i>High-temperature solid oxide fuel cells: fundamentals, design and applications</i>. Elsevier, 2003.</p> <p>HUANG, Kevin; GOODENOUGH, John B. <i>Solid oxide fuel cell technology: principles, performance and operations</i>. 2009.</p> <p>GODULA-JOPEK, Agata. <i>Hydrogen production: by electrolysis</i>. John Wiley &amp; Sons, 2015</p>	
	Supplementary literature	LARMINIE, James; DICKS, Andrew; MCDONALD, Maurice S. <i>Fuel cell systems explained</i> . Chichester, UK: J. Wiley, 2003.	
	eResources addresses	<p>Adresy na platformie eNauczenie:</p> <p>OGNIWA PALIWOWE I ELEKTROLIZERY  WYSOKOTEMPERATUROWE [TWiE][2024/25] - Moodle ID: 39915  <a href="https://enauczenie.pg.edu.pl/moodle/course/view.php?id=39915">https://enauczenie.pg.edu.pl/moodle/course/view.php?id=39915</a></p>	
Example issues/ example questions/ tasks being completed	Describe the designs and generations of fuel cells		
Work placement	Not applicable		

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