GDAŃSK UNIVERSITY OF TECHNOLOGY

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 WETI -> 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 Ekhlasiosgouei	

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

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lab</td><td>50.0%</td><td>40.0%</td></tr>
<tr><td>Lecture - test</td><td>50.0%</td><td>60.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>SINGHAL, Subhash C.; KENDALL, Kevin (ed.). High-temperature solid oxide fuel cells: fundamentals, design and applications. Elsevier, 2003.

HUANG, Kevin; GOODENOUGH, John B. Solid oxide fuel cell technology: principles, performance and operations. 2009.

GODULA-JOPEK, Agata. Hydrogen production: by electrolysis. John Wiley & Sons, 2015</td></tr>
<tr><td>Supplementary literature</td><td>LARMINIE, James; DICKS, Andrew; MCDONALD, Maurice S. Fuel cell systems explained. Chichester, UK: J. Wiley, 2003.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
OGNIWA PALIWOWE I ELEKTROLIZERY WYSOKOTEMPERATUROWE [TWiE][2024/25] - Moodle ID: 39915
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39915</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Describe the designs and generations of fuel cells</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
</table>

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