GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fuel Cells and Electrolysers, PG_00070191		
Field of study	Hydrogen Technologies and Electromobility		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group 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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Sebastian Molin	
	Teachers	prof. dr hab. inż. Piotr Jasiński dr inż. Szymon Potrykus dr hab. inż. Sebastian Molin	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=5646

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	3.0	27.0	75

Subject objectives

The course provides in-depth knowledge of the construction, operating principles and properties of low- and high-temperature fuel cells and electrolysers. It covers the thermodynamic and kinetic fundamentals of electrochemical processes, materials and components, characterisation methods and degradation mechanisms. In the laboratory, students measure the operating characteristics of fuel cells and electrolysers and analyse the results. The course prepares students for research and engineering work in hydrogen technologies.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W08] knows and understands, to an increased extent, the fundamental dilemmas of modern civilisation, the main development trends of scientific disciplines relevant to the hydrogen technologies and electromobility	The student knows and understands the main development trends of fuel cell and electrolyser technologies and their role in the energy transition and the development of the hydrogen economy.	[SW1] Assessment of factual knowledge
	[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of hydrogen technologies and electromobility, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of hydrogen technologies and electromobility, including computer simulations, interpret the obtained results and draw conclusions	The student is able to measure current-voltage and impedance characteristics of fuel cells and electrolysers, select experimental conditions, interpret the obtained results and draw conclusions regarding the efficiency and condition of the tested device.	[SU4] Assessment of ability to use methods and tools
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of hydrogen technologies and electromobility, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	The student is able to select components and assemble a fuel cell or electrolyser test setup according to a given specification, start it up and evaluate its operating parameters.	[SU1] Assessment of task fulfilment
	[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the hydrogen devices, systems, installations, and automation systems	The student knows and understands the physical and electrochemical phenomena underlying the operation of fuel cells and electrolysers, including the thermodynamic and kinetic fundamentals of electrode processes and the relationships between design, materials and operating parameters of these devices.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture W1 – Fundamentals of fuel cell and electrolyser operation. High-temperature fuel cells and electrolysers, part I: SOFC/SOEC operating principles, electrolyte and electrode materials. W2 – High-temperature fuel cells and electrolysers, part II: interconnects, stacks, degradation mechanisms, CO_2 /H_2O co-electrolysis. W3 – High-temperature protonic cells: proton-conducting electrolytes, electrode materials, development trends. W4 – PEM fuel cells and electrolysers: design, membranes, catalysts, operating conditions, applications. W5 – Low-temperature electrolysers (alkaline, AEM): designs, electrode materials, operating parameters and efficiency. W6 – Biofuel cells: microbial and enzymatic cells — operating principles, materials, limitations and applications. Course content – laboratory L1 – Electrochemical measurements with a reference electrode: cell configuration, separation of electrode overpotentials. L2 – Solid oxide electrolyser (SOEC) testing: current-voltage characteristics, operating conditions. L3 – Alkaline electrolysers: polarisation curves, determination of electrolysis efficiency. L4 – PEM electrolyser: performance measurements, effect of operating parameters on efficiency. L5 – PEM fuel cell (PEMFC): current-voltage characteristics, data analysis and report preparation.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
written exam	50.0%	70.0%
laboratory reports	50.0%	30.0%

Recommended reading	Basic literature	R. O'Hayre, S.-W. Cha, W. Colella, F.B. Prinz, *Fuel Cell Fundamentals*, Wiley A. Godula-Jopek (ed.), *Hydrogen Production by Electrolysis*, Wiley-VCH
	Supplementary literature	J. Larminie, A. Dicks, *Fuel Cell Systems Explained*, Wiley F. Barbir, *PEM Fuel Cells: Theory and Practice*, Academic Press
	eResources addresses	
Example issues/ example questions/ tasks being completed	Determination of the Nernst voltage and efficiency of a fuel cell; comparison of electrolyser technologies (alkaline / PEM / AEM / SOEC); interpretation of a polarisation curve and an impedance (EIS) spectrum; degradation mechanisms of PEM and solid oxide cells; the role of the reference electrode in separating electrode overpotentials; operating principles and limitations of biofuel cells.	
Practical activites within the subject	Not applicable	

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