



Subject card

Subject name and code	Hydrogen power and fuel cells, PG_00037309						
Field of study	Technical Physics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2027/2028		
Education level	first-cycle studies		Subject group		Optional 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	3		Language of instruction		Polish Classes are conducted in Polish and English; in the case of foreign students, classes are conducted exclusively in English.		
Semester of study	5		ECTS credits		1.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Division of Molecular Photophysics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Piotr Grygiel				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15		2.0		8.0	25
Subject objectives	Knowledge of the operating principles of different types of fuel cells. Knowledge of issues related to the design and proper operation of fuel cells. Knowledge of the functioning of fuel cell systems. Knowledge of industrial methods of hydrogen production and storage.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_W01] understands the importance of physics and its applications in connection to civilization		Understands the civilisational significance of various fields of physics and technology applicable to hydrogen energy.		[SW1] Assessment of factual knowledge		
	[K6_U01] learns independently, obtains information from literature, databases and other properly selected sources		They are able to independently acquire knowledge on various aspects of hydrogen energy, independently obtaining information from literature, databases and industry sources.		[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools		

Subject contents	Course content – lecture 1. Historical, evolution of types and construction of fuel cells. 2. Electrode reactions, the equation of electromotive force: cathodic and anodic reactions on for a hydrogen fuel cell, derivation of basic equation for the electromotive force regardless of losses. 3. Efficiency: term of efficiency, thermodynamic efficiency, derivation of formulae for efficiency of fuel cells. 4. The influence of pressure and gas concentration on the electromotive force of a fuel cell: the influence of oxygen and hydrogen partial pressures, the influence of fuel and oxidant utilisation, the influence of pressure in a cell, the influence of means of oxygen supply. 5. Operational cell voltage. Kinds of voltage losses in a cell: the current - voltage characteristics of chosen fuel cells, the reasons for the voltage losses and their classification. 6. Activation losses: the charge double layer, Tafel equation, derivation of equation for the magnitude of losses, the means of minimization of fuel cells losses. 7. The fuel crossover and internal currents losses: the origin, derivation of equation for the magnitude of losses. 8. The Ohmic and concentration losses: the origin, derivation of equation for the magnitude of losses, the means of minimization of fuel cells losses. 9. The summary equation of losses. 10. The dynamic features of fuel cells: the equivalent circuit of a fuel cell, the test of current interrupt as the method for identification and measurement of magnitude of losses, the dynamic characteristics of chosen types of cells. 11. Some details of fuel cells construction. Contemporary types of fuel cells: the basic features of fuel cells construction, construction of electrodes, connection of cells, bipolar plate, summary of basic parameters and applications of fuel cells. 12. Energetic systems using PEM, AFC, PAFC, MCFC, SOFC cells. 13. Types and basics of fuel processing. 14. Fuel reforming systems. 15. Hydrogen storage. 16. Fuel cells as a source of alternating current.		
Prerequisites and co-requisites	1. Basic knowledge of organic and inorganic chemistry. 2. Basic knowledge of thermodynamics of chemical reactions. 3. Basic knowledge of electrochemistry. 4. Basic knowledge of electric circuits theory.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Credit for the course (written form)	50.0%	100.0%
Recommended reading	Basic literature	1. J. Larminie, A. Dicks „Fuel cell systems explained, Wiley, 2003. 2. K. Kordesch, G. Simader „Fuel cells and their applications, VCH, 2001. 2. K. Kordesch, G. Simader Fuel Cells and Their Applications, VCH, 1996	
	Supplementary literature	1. P. W. Atkins: „Physical Chemistry", Oxford University Press, 2018	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Derivation of the formula for the electro motive force of a hydrogen fuel cell. The influence of the presence of water on the work of a PEM fuel cell.		
Practical activities within the subject	Not applicable		

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