GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Hydrogen technologies and alternative fuels, PG_00072673						
Field of study	Chemical Technology, Chemistry, Biotechnology, Engineering and Technologies of Energy Carriers, Corrosion , Green Technologies, InfoBioChem						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Jacek Gębicki				
	Teachers						
Lesson types	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		5.0	25.0	75	
Subject objectives	The aim of the course is to familiarize students with the properties of hydrogen as a fuel and as a feedstock for the chemical industry, with traditional and alternative methods of hydrogen production, as well as with methods of its storage, distribution, and use in the synthesis of e-fuels. Students will acquire theoretical knowledge and practical skills related to electrolysis technologies, fuel cells, on-demand hydrogen production, hydrogen purification, the use of hydrogen in e-fuel synthesis, and simulations of the profitability of hydrogen investments.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U04] predicts the properties of the materials obtained and the course of processes involving them, based on knowledge of technology and related fields and computer methods of data analysis, modelling and simulation	is able to analyze and predict the properties of materials and the course of processes related to the production, storage, and use of hydrogen and alternative fuels, using computer-based methods of data analysis, modeling, and simulation.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_U08] assesses the potential for commercialisation of a product or technology based on an analysis of scientific publications and patents	is able to analyze scientific publications and patents related to hydrogen technologies and alternative fuels, and assess the commercialization potential of a selected product or technology.	[SU2] Assessment of ability to analyse information
[K7_W01] defines the phenomena, processes and laws of nature used to produce consumer goods and provide services	knows and defines physicochemical phenomena and fundamental laws of nature describing processes related to the production, storage, and use of hydrogen and alternative fuels.	[SW1] Assessment of factual knowledge
[K7_W02] selects appropriate apparatus and materials for the manufacture and processing of consumer goods	understands the relationship between material properties, process parameters, and the selection of equipment used for the production, processing, and storage of hydrogen and alternative fuels.**	[SW1] Assessment of factual knowledge
[K7_U02] carries out experiments using properly selected techniques and apparatus, taking advantage of new developments in technology and related fields	is able to plan and conduct experiments related to hydrogen technologies and alternative fuels using appropriately selected techniques, equipment, and current technological developments in the field.	[SU4] Assessment of ability to use methods and tools

Subject contents

Course content – lecture

- Properties of hydrogen as a fuel and as a feedstock for the chemical industry
- Traditional methods of hydrogen and syngas production
- Water electrolysis technologies and fuel cells
- Alternative methods of hydrogen production: on-demand hydrogen production using liquid hydrogen carriers (LOHCs, methanol, ammonia)
- Alternative methods of hydrogen production: thermochemical water splitting, photoelectrochemical water splitting, photobiological processes, microbial biomass conversion
- Hydrogen purification, carbon dioxide capture and storage
- Hydrogen storage and distribution
- Methods for utilizing hydrogen and waste carbon dioxide in the synthesis of e-fuels
- Final assessment

Course content – laboratory

- Water electrolysis – alkaline electrolyzer
- Design and preparation of catalysts for e-fuel synthesis
- Use of hydrogen and waste carbon dioxide for e-fuel synthesis: synthesis of e-methanol and e-methane
- On-demand hydrogen production:
  a) Steam reforming of methanol
  b) Catalytic decomposition of sodium borohydride
- Photocatalytic methods of hydrogen production
- Simulation of the profitability of hydrogen investments – computer laboratory
- Completion of missed laboratory classes

Prerequisites and co-requisites

Fundamental knowledge of chemical technology.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture - test	60.0%	60.0%
Laboratory classes - tests, reports	100.0%	40.0%

Recommended reading

Basic literature	Hydrogen Technology: Fundamentals and Applications, ed. M.R. Cesario, A. J. Menezes de Araujo, F.J. Almeida Loureiro, D. Araujo de Macedo, Elsevier, Amsterdam, 2024.
Supplementary literature	Handbook of Fuels: Energy Soruces for Transportation, ed. B. Elvers, A. Schutze, Wiley-VCH GmbH, 2022.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Discuss the properties of hydrogen as a fuel and compare them with conventional fuels. 2. Present the operating principle of a PEM fuel cell. 3. Explain the process of on-demand hydrogen production from methanol and ammonia. 4. Analyze the efficiency of various hydrogen storage methods: liquid hydrogen, LOHCs, and compressed gas. 5. Design an e-fuel synthesis process using hydrogen technologies and assess the profitability of the investment.
Practical activites within the subject	Not applicable

Document generated electronically. Does not require a seal or signature.