



Subject card

Subject name and code	Hydrogen transport and storage, PG_00064573						
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					
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	Department of Control Engineering -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Adam Kielak					
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	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	30	0.0		0.0		30
Subject objectives	Acquisition of knowledge concerning: methods of hydrogen transport and storage, thermodynamic phenomena related to these processes and technologies used in hydrogen storage in various states of matter, including liquid, gaseous and solid, as well as safety methods related to the handling and transport of hydrogen.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U08] can design and build systems and devices related to automation systems, mechatronics and robotics in energy storage devices and in hydrogen installations	He designs simple automation systems in energy and hydrogen storage devices.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K6_K01] is aware of the need for continuous education and self-improvement in the field of the profession of an electrician and knows the possibilities of further education	Stay tuned for the latest information on hydrogen technologies. He selects the information found to the issues under consideration,	[SK4] Assessment of communication skills, including language correctness
	[K6_W13] knows the properties of materials used in the field of hydrogen energy and electromobility	It selects materials according to the requirements of the hydrogen transport or storage method used.	[SW1] Assessment of factual knowledge
	[K6_W08] has basic knowledge in the field of energy storage systems: mechanical, thermal, electrical and others, knows the basics of thermodynamics and fluid mechanics, as well as the construction and operation of thermal energy equipment, hydrogen installations, process equipment, including renewable energy sources	It selects energy storage systems adapted to the generation sources. Applies the principles of fluid mechanics and thermodynamics in the selection of components of energy systems.	[SW1] Assessment of factual knowledge
[K6_U05] can use analytical and simulation methods, prepare and for the formulation and solution of tasks in the field of hydrogen technologies, automation and robotics, electrical engineering, use various techniques to carry out engineering tasks related to electrical devices, hydrogen installations, control and robotics systems	It defines the elements of automation and robotics systems in the control and support systems for the operation of hydrogen installations and hydrogen-based fuels.	[SU2] Assessment of ability to analyse information	
Subject contents	Pipeline transport. Transport of a mixture of hydrogen and methane. Storage. Technologies used in the storage of hydrogen in various states of matter: liquid, gas, and solid. Chemical compounds used to transport hydrogen. Thermodynamic aspects of hydrogen storage charging. Thermodynamic aspects of hydrogen storage discharge. Safety of transport and storage.		
Prerequisites and co-requisites	Basic knowledge of thermodynamics, fluid mechanics and chemistry.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Colloquium	60.0%	100.0%
Recommended reading	Basic literature	1. Rahimpour, M. R., Makarem, M. A., & Kiani, P. (2024). <i>Hydrogen Transportation and Storage</i> . Routledge. 2. Turner, J. A., & Pivovar, B. (2022). <i>Hydrogen Energy: Production, Safety, Storage, and Applications</i> . Wiley. 3. Fennell, P. S., & Sherwood, J. (2023). <i>Sustainable Hydrogen Energy: Production, Storage & Transportation</i> . MIT Press.	
	Supplementary literature	1. Menon, E. S. (2005). <i>Gas Pipeline Hydraulics</i> . CRC Press.	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	Pipeline transport of flammable gases. Pipeline transport of a mixture of methane and hydrogen. Negative Joule-Thomson effect when filling and emptying hydrogen tanks. Large-scale hydrogen storage in salt caverns. Chemical compounds that enable hydrogen storage. Hydrogen transport technologies depending on the distance between the place of production and the place of use. Cylinder bundles pressures, capacities, methods against excessive pressure increase and decrease. Hydrogen tanks used in road and rail transport. Seals used in hydrogen storage and transport technologies.		
Work placement	Not applicable		

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