



## Subject card

Subject name and code	, PG_00060037						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2024/2025		
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	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		Joanna Wysocka  prof. dr hab. inż. Piotr Jasiński  Magdalena Wysocka  dr hab. inż. Sebastian Molin				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	15.0	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		30.0	80
Subject objectives	The objective of the course "Energy Storage Methods" is to provide students with a thorough understanding of various energy storage technologies and their applications in practical scenarios. Students learn the basic principles of energy storage, such as electrochemical, thermal, and mechanical storage methods, and how these methods impact the efficiency and stability of energy systems. The course also aims to understand the challenges associated with integrating energy storage into sustainable and decentralized energy systems.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W07] knows the environmental effects of energy technologies used; is familiar with the issues of effective energy management and use of renewable energy sources, has a broad and well-established knowledge of the processes of energy production and use		Can rationalize the effect of new energy conversion technologies, their implementation, on the economic and environmental aspects in the broad context.		[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	[K7_U02] is able to use known mathematical and numerical methods to analyze and design elements, systems and power transmission networks and internal installations		Students distinguish processes related to the exploitation of energy resources and use fundamental concepts from the field of energy		[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		

Subject contents	1. Introduction to Energy Storage 2. Energy in Traditional Carriers: Coal, Oil, Gas 3. Basic Electrochemical Batteries (Lead-Acid, Flow Batteries) 4. Modern Electrochemical Batteries (Lithium-Ion, Flow Batteries) 5. Energy Storage in Electric Vehicles 6. Generation and Storage of Hydrogen Energy 7. Hydrogen Storage: Hydrides, Compressed, Liquid 8. Supercapacitors 9. Chemical Energy Storage: Methanol, Ammonia, Biofuels 10. Thermal Energy Storage (PCM, Water Systems, Rocks) 11. Mechanical Energy Storage - Compressed Air (CAES), Flywheels, Gravitational Energy Storage 12. Hydraulic Energy Storage Systems (PHES) 13. Nuclear Energy - Nuclear Fuel 14. Energy Storage in Energy Grids 15. Case Studies - Analysis of Cases		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory	80.0%	25.0%
	Final test	50.0%	75.0%
Recommended reading	Basic literature	1. Barnes F. S., Levine J. G., Large Energy Storage Systems Handbook, CRC Press, Taylor and Francis Group, 2011 2. Ahmed Faheem Zobaa, Energy Storage - Technologies and Applications, InTech 2013. ISBN 978-953-51-0951-8, DOI: 10.5772/2550;http://www.intechopen.com/books/energy-storage-technologies-and-applications 3. Rafi qul Islam Sheikh, Energy Storage, InTech 2010, ISBN 978-953-307-119-0; http://www.intechopen.com/books/energy-storage	
	Supplementary literature	1) publications from Elsevier, Wiley publishing houses (and others)  2) internet resources	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	1. Please describe the basic methods of energy storage in Poland? 2. Please describe a possible energy storage scenario 20 years from now? 3. What technologies can be used for storing energy on a small and large scale?		
Work placement	Not applicable		

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