



Subject card

Subject name and code	, PG_00060037						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2023/2024		
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 WET1 -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Piotr Jasiński					
	Teachers	dr inż. Iga Szpunar prof. dr hab. inż. Piotr Jasiński 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_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			[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject		
	[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.			[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		
Subject contents	<ol style="list-style-type: none">1. Introduction to Energy Storage2. Energy in Traditional Carriers: Coal, Oil, Gas3. Basic Electrochemical Batteries (Lead-Acid, Flow Batteries)4. Modern Electrochemical Batteries (Lithium-Ion, Flow Batteries)5. Energy Storage in Electric Vehicles6. Generation and Storage of Hydrogen Energy7. Hydrogen Storage: Hydrides, Compressed, Liquid8. Supercapacitors9. Chemical Energy Storage: Methanol, Ammonia, Biofuels10. Thermal Energy Storage (PCM, Water Systems, Rocks)11. Mechanical Energy Storage - Compressed Air (CAES), Flywheels, Gravitational Energy Storage12. Hydraulic Energy Storage Systems (PHES)13. Nuclear Energy - Nuclear Fuel14. Energy Storage in Energy Grids15. Case Studies - Analysis of Cases						

Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Final test	50.0%	75.0%
	Laboratory	80.0%	25.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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		