GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00060037						
Field of study	Environmental Engineering						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group	Optional 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	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Piotr Jasiński					
	Teachers						
Lesson types	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_W06	The student has in-depth and well-organized knowledge of the physical and technical fundamentals of electrical and thermal energy storage, particularly the processes of heat, mass, and electric charge transport that occur in energy storage systems, and understands the principles of their integration with power and heating systems.	[SW1] Assessment of factual knowledge
K7_U12	The student is able to conduct a technical and economic analysis of various electrical and thermal energy storage technologies, evaluate their energy efficiency, investment and operating costs, and durability, and identify the optimal solution for specific operating conditions and applications in energy systems and environmental engineering installations.	[SU3] Assessment of ability to use knowledge gained from the subject
K7_U10	The student is able to select and design an electrical or thermal energy storage system, taking into account energy requirements, technical parameters, efficiency, operational safety, and environmental and economic conditions, as well as perform basic design calculations and justify the choice of the selected solution.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W11] has knowledge to analyze, evaluate and optimize processes, objects and systems of environmental engineering and knows the principles of rational energy management and resources	The student has knowledge of different types of energy storage systems, including mechanical, thermal and electrical. Understands the principles of construction and operation of thermal power equipment, hydrogen systems and process apparatus, including systems using renewable energy sources.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

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

Course content – project

Selection, sizing, and technical and economic evaluation of an electrical or thermal energy storage system for a selected facility or environmental engineering installation.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	50.0%	70.0%
Laboratory	50.0%	30.0%

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	publications from Elsevier, Wiley publishing houses (and others)
	eResources addresses	
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?	
Practical activites within the subject	Not applicable	

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