GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Energy storage metchods, PG_00058343		
Field of study	Hydrogen Technologies and Electromobility		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Piotr Jasiński	
	Teachers	dr inż. Joanna Wysocka 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	30.0	0.0	0.0	60

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	60	8.0	57.0	125

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
[K6_W08] has 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	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
[K6_U01] Is able to obtain information from literature, databases and other sources, integrate them, interpret them and draw conclusions and formulate opinions; has the ability to self-educate m.in. in order to improve professional competences	The student is able to identify and utilize various sources of information, such as scientific articles, databases, and technical standards, related to various energy storage technologies.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[K6_K02] can work in a group taking on different roles in it	The student knows how to work in group, knows different group roles and understands how to divide tasks and responsibility.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work

<table>
<tr><td>Subject contents</td><td>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</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Final test</td><td>50.0%</td><td>75.0%</td></tr>
<tr><td>Laboratory</td><td>80.0%</td><td>25.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>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</td></tr>
<tr><td>Supplementary literature</td><td>1) publications from Elsevier, Wiley publishing houses (and others)

2) internet resources</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>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?</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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