GDAŃSK UNIVERSITY OF TECHNOLOGY

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 WETI -> 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

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

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2"></td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><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 rowspan="3">Recommended reading</td><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>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">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 colspan="2">Not applicable</td></tr>
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