GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Energy storage, PG_00055910		
Field of study	Power Engineering, Power Engineering, Power Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Optional subject group 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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Maszyn Przepływowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marian Piwowarski	
	Teachers	dr hab. inż. Marian Piwowarski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

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	15	1.0	9.0	25

Subject objectives

The aim of the course is to provide knowledge of energy storage (electrical, mechanical, thermal).

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W11] has knowledge of known technologies and non-technical aspects to solve simple engineering tasks in the field of energy systems and devices	The student is able to use the knowledge of the operation of energy devices associated with energy storage to assess the technical condition of such systems. Can perform simple calculations to determine the basic technical parameters of thermal energy storage.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K6_W10] knows the basic installations in the field of renewable energy sources and their impact on the environment	The student has knowledge of the use of renewable sources in thermal energy storage systems. In particular, in the use of solar and photovoltaic installations, wind turbines and biomass.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
[K6_U06] is able to use the basic knowledge on the operation of energy equipment in the field of thermal power plants, thermal and energy and heating systems, combustion engines, compressors and rotating machines to assess the technical condition of the system	The student is able to use the knowledge of the operation of energy devices associated with energy storage to assess the technical condition of such systems.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

Subject contents

Pumped hydropower energy storage (PHES); Compressed air energy storage (CAES); Liquid air energy storage (LAES, CES); Flywheel energy storage (FES); Chemical energy storage; Electricity storage; Low-, medium-, high-temperature heat and cooling storage (TES)

Prerequisites and co-requisites

Mathematics, Physics, Fluid mechanics, thermodynamics, heat transfer, modeling of two-phase flows.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture	50.0%	100.0%

Recommended reading	Basic literature	1. Domański R., Magazynowanie energii cieplnej, PWN, Warszawa, 1990 2. Klugmann-Radziemska E. et all, Energetyka i ochrona środowiska. Generowanie i magazynowanie energii, PWN, Warszawa, 2023 3. Zobaa A. F., Energy Storage - Technologies and Applications, 2013 4. Chmielewski A., Kupecki J., Szabłowski Ł., Fijałkowski K.J., Zawieska J., Bogdziński K., Kulik O. i Adamczewski T., Dostępne i przyszłe formy magazynowania energii, Fundacja WWF Polska, Warszawa, 2020
	Supplementary literature	1. Huggins R. A. Energy Storage Springer Science plus Business Media, 2010 2. Mirek P., Technika magazynowania energii w ciekłym powietrzu, Polityka Energetyczna - Energy Policy Journal, Tom 19, Zeszyt 1, pp. 7386, 2016
	eResources addresses	Adresy na platformie eNauczanie: Magazyny energii (PG_00055910) - Moodle ID: 38346 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=38346
Example issues/ example questions/ tasks being completed	1 Explain the idea of a pumped storage power plant 2 Compare the diabatic and adiabatic form of energy storage in compressed air3. List the most commonly used batteries of electrical energy in technology	
Work placement	Not applicable	