



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 2022	Academic year of realisation of subject			2024/2025		
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 Ogrzewnictwa, Wentylacji, Klimatyzacji i Chłodziactwa -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Rafał Andrzejczyk				
	Teachers						
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 in the field of energy storage in the field of single-phase and latent heat thermal energy storage.						
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_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		
	[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 energy 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		
Subject contents	Lecture: 1. Basics of using thermal energy storage in technology. 2. Classification of substances used to thermal energy store 3. Sensible heat thermal energy storage. 4. Latent heat thermal energy storage. 5. Heat transfer during the melting process. 6. Heat transfer during the solidification process. 7. Energy efficiency of thermal energy storage systems						
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		56.0%		100.0%		

Recommended reading	Basic literature	<p>1. Roman Domański,, Thermal energy storage, State Publisher Scientific (1990)</p> <p>2. Zygmunt Lipnicki, Dynamic of Liquid Solidification: Thermal Resistance of Contact Layer</p> <p>3. Amy S. Fleischer, Thermal Energy Storage Using Phase Change Materials, Fundamentals and Applications, Springe 2015</p> <p>4. Wolf-Dieter Steinmann, Thermal Energy Storage for Medium and High Temperatures, Concepts and Applications, Springer 2022</p>
	Supplementary literature	<p>1. Harald Mehling , Heat and cold storage with PCM, Springer 2008</p> <p>2. Amir Faghri and Yuwen Zhang , Fundamentals of Multiphase Heat Transfer and Flow, Springer 2019</p>
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>1. Determine the physical meaning of the Fourier number 2. Specify criteria for selecting materials for energy storage 2. Discuss the physics of the melting phenomenon for the selected type of phase change substance. 4. Discuss the physics of solidification for a selected type of phase change substance</p>	
Work placement	Not applicable	