GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00070388		
Field of study	Materials Engineering, Materials Engineering		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of New Functional Materials For Energy Conversion -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Beata Bochentyn	
	Teachers	dr hab. inż. Beata Bochentyn	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	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	6.0	49.0	100

Subject objectives

The aim of the course is to familiarize students with the basic principles of energy conversion and methods of energy storage. During the classes, selected technologies of energy conversion and storage and their role in modern energy systems are discussed. The course also presents the possibilities of using these technologies in various areas of the energy sector and in modern energy applications.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] Can critically analyze and evaluate the functioning – particularly in the context of materials engineering –existing technical solutions, particularly equipment, objects, systems, processes.	The student is able to critically evaluate the performance of selected energy conversion systems, including aspects such as energy losses, efficiency, and long-term stability. The student is also able to present the results of their analysis.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
[K6_W03] Has knowledge of materials science and can relate the properties of materials with their structure and composition, knows the theoretical description of phenomena occurring in materials subjected to external factors.	The student knows how the structure and composition of materials influence properties relevant to energy storage and conversion. The student is familiar with the theoretical description of phenomena occurring in these materials under the influence of external factors related to energy conversion.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K6_U01] Can properly use selected analytical, simulation and experimental methods, as well as devices for measuring the fundamental properties of materials and technological processes.	The student is able to select appropriate experimental methods and tools for the proper analysis of data describing selected energy conversion processes.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information

Subject contents

Course content – lecture

- Physical principles of energy conversion
- Fundamentals of electrochemistry
- Fuel cells
- Power-to-gas
- Batteries, capacitors, etc.
- Thermoelectric devices
- Solar energy
- Wind energy
- Hybrid systems
- Thermal energy storage
- Hydropower
- Nuclear energy
- Applications of energy storage (electromobility, smart grids, etc.)

Course content – laboratory

Design, fabrication, functionalization, and characterization of a low-temperature alkaline electrolyzer.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	50.0%
Completion of laboratory tasks.	100.0%	50.0%

Recommended reading

Basic literature	• Odnawialne źródła energii. Red. Wichliński, Michał . Częstochowa: Politechnika Częstochowska, 2021, ISBN 978-83-7193-867-2 • Proekologiczne odnawialne źródła energii. Kompendium, Witold M. Lewandowski, Ewa Klugmann-Radziemska, 2022, ISBN: 978-83-01-19067-5 • Nanostructured Materials for Next-Generation Energy Storage and Conversion, ed. Ying-Pin Chen, Sajid Bashir, Jingbo Louise Liu, Springer 2017 • Nanomaterials for Energy Storage Systems - Review, Habeeb Mohammed et al., Molecules 2025, 30, 883
Supplementary literature	brak
eResources addresses	

Example issues/ example questions/ tasks being completed

1. State and explain the Nernst equation.
2. What material requirements should be met by materials used for the anode, cathode, and electrolyte of a solid oxide fuel cell?
3. Describe the sources of losses in a solid oxide fuel cell.

Practical activites within the subject

Not applicable

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