GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Selected Aspects of Functional Materials Engineering, PG_00064572		
Field of study	Hydrogen Technologies and Electromobility		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Sebastian Molin	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

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	30	0.0	0.0	30

Subject objectives

The aim of the course is to acquaint students with the latest achievements and trends in the engineering of functional materials, with a particular focus on research conducted within the Department of Functional Materials Engineering. Students will gain knowledge about the design, synthesis, and applications of modern materials, such as composite materials, nanomaterials, and smart materials. The course aims to develop skills in analyzing and evaluating the properties of materials and their potential applications in various industries, including electronics, energy, and medicine. Students will also be involved in research projects, allowing them to apply their acquired knowledge practically and develop skills in working within a research team.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U05] can use analytical and simulation methods, prepare and for the formulation and solution of tasks in the field of hydrogen technologies, automation and robotics, electrical engineering, use various techniques to carry out engineering tasks related to electrical devices, hydrogen installations, control and robotics systems	Is able to select and apply appropriate analytical, simulation, and experimental techniques to evaluate the properties of functional materials. Can interpret measurement results and draw conclusions regarding their application in electrochemical and energy devices.	[SU4] Assessment of ability to use methods and tools
[K6_U08] can design and build systems and devices related to automation systems, mechatronics and robotics in energy storage devices and in hydrogen installations	The student can design and construct systems and devices related to energy storage and hydrogen installations. They are able to integrate modern functional materials into projects, optimizing their performance and reliability. They can apply acquired knowledge to practical engineering solutions.	[SU1] Assessment of task fulfilment
[K6_K01] is aware of the need for continuous education and self-improvement in the field of the profession of an electrician and knows the possibilities of further education	The student is aware of the need for continuous education in the field of functional materials engineering. They understand the importance of self-improvement for professional development in the context of rapidly changing technologies. They know the available pathways for further education, such as specialized courses, postgraduate studies, and industry conferences, which enable them to update their knowledge and skills.	[SK3] Assessment of ability to organize work
[K6_W07] knows the basics of computer programming, digital circuits, microprocessor technology, design of simple algorithms, principles of operation of computer networks	Knows the fundamentals of programming and computer techniques used for modelling and analysing the properties of functional materials. Understands the principles of operation of microprocessors and measurement systems supporting materials research.	[SW1] Assessment of factual knowledge
[K6_W13] knows the properties of materials used in the field of hydrogen energy and electromobility	The student can identify and characterize the properties of materials used in hydrogen energy and electromobility. They understand the application of composite materials, light metal alloys, and nanomaterials in the context of energy storage and drivetrain efficiency. They can assess the impact of these materials on the efficiency and durability of hydrogen and electric technologies.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Lecture (15h):

1. Introduction: basic concepts (1h)
2. Applications of oxide fuel cells and electrolyzers, sensors (2h)
3. Proton conductors: basic research and applications (2h)
4. New materials and electrodes for alkaline electrolyzers (2h)
5. High-temperature corrosion phenomena and prevention (2h)
6. Hydrogels: basic research and applications (1h)
7. Conductive polymers: basic research and applications (1h)
8. Conversion of energy from renewable sources into green fuels (Power-to-X) (2h)
9. Microelectronic systems for energy harvesting (2h)

Laboratory (15h):Laboratory exercises reinforcing lecture content, chosen by students: 5 exercises x 3h, e.g., synthesis of materials by solid-state reaction, study of ionic conductors using impedance spectroscopy, construction and testing of an alkaline electrolyzer with various electrodes, optical and electron microscopy in material studies, prototyping materials using 3D printing methods.

Course content – laboratory
1. High temperature fuel cells;
2. Energy harvesting;
3. High temperature corrosion;
4. Electrospinning;
5. Alkaline electrolysis;
6. SOC electrodes;</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>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>1. Hydrogen production: by Electrolysis, Agata Godula-Jopek, Wiley-WCH, 2015
2. Hydrogen Energy Engineering, seria Green Energy and Technology, Kazunari Sasaki, Hai-Wen Li, Akari Hayashi, Junichiro Yamabe, Teppei Ogura, Stephen Lyth, Springer, 2016</td></tr><tr><td>Supplementary literature</td><td>• Scientific and technical literature from databases: Elsevier, Wiley, Springer, Google Scholar</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Please describe the construction of low-temperature electrolyzers and the basic materials used in their construction.
2. Please describe possible processes for the production of biohydrogen and the role of catalysts in the process.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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