



Subject card

Subject name and code	, PG_00065835						
Field of study	Materials Engineering						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2024/2025		
Education level	second-cycle studies	Subject group			Specialty 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	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Maria Gazda					
	Teachers	prof. dr hab. inż. Maria Gazda					
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	5.0	20
	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	20		5.0		25.0	50
Subject objectives	The aim of the course is to learn about the materials and technologies used in the conversion of light into other forms of energy, especially electricity.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W01] Has extended knowledge of the fields of science and scientific disciplines relevant to materials engineering, and their historical development and importance for the progress of exact and natural sciences, knowledge of the world and evolution of humanity.	has extensive knowledge of materials engineering, its importance and impact on the development of new energy sources, especially photovoltaics			[SW1] Assessment of factual knowledge		
	[K7_U06] Can evaluate usefulness and feasibility of using new achievements (techniques and technologies) within the scope of materials science.	is able to assess the usefulness and possibility of using new achievements in materials and technologies for photovoltaics			[SU1] Assessment of task fulfilment		

Subject contents	<p>Lecture</p> <p>Introduction:1) Optical properties of materials: absorption, refraction and reflection coefficient;2) Generation and recombination of charge carriers in a semiconductor;3) Internal photoelectric effect;Principle of operation of a photovoltaic cell:1) Phenomena;2) Energy conversion efficiency;3) Factors influencing energy conversion efficiency;Photovoltaic cell design, materials used and solutions on the example of a silicon cell: 1) Emitter and base;2) Antireflection layers;3) Electrodes;4) Amorphous silicon thin-film cells;Other materials and technologies:1) CdTe thin-film cells, CIGS, perovskite cells;2) Photoelectrochemical cells, biocells;3) Multi-junction cells;4) Light focusing;</p> <p>Solar panels:1) Materials and solutions used in panels;2) Application of panels;3) Comparison of different technologies; Other devices using the internal photoelectric effect (photoresistors, photodiodes) and materials and technologies used to manufacture them.</p> <p>Summary: limitations, perspectives, applications</p> <p>Seminar: Discussion between students on issues related to the use of photovoltaic cells, the profitability of their use, forecasts for the future and problems related to their recycling.</p>											
Prerequisites and co-requisites	Basic knowledge on semiconductors											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>presence and presentation assesment</td> <td>51.0%</td> <td>10.0%</td> </tr> <tr> <td>written work: open questions</td> <td>51.0%</td> <td>90.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	presence and presentation assesment	51.0%	10.0%	written work: open questions	51.0%	90.0%
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Recommended reading	<table border="1"> <tbody> <tr> <td>Basic literature</td> <td colspan="2">https://epodreczniki.open.agh.edu.pl/handbook/35/module/1079/reader</td> </tr> <tr> <td>Supplementary literature</td> <td colspan="2">scientific literature</td> </tr> <tr> <td>eResources addresses</td> <td colspan="2"> Podstawowe https://epodreczniki.open.agh.edu.pl/handbook/35/module/1079/reader - e textbook, AGH Adresy na platformie eNauczenie: Materiały dla Fotowoltaiki - Moodle ID: 15185 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=15185 </td> </tr> </tbody> </table>			Basic literature	https://epodreczniki.open.agh.edu.pl/handbook/35/module/1079/reader		Supplementary literature	scientific literature		eResources addresses	Podstawowe https://epodreczniki.open.agh.edu.pl/handbook/35/module/1079/reader - e textbook, AGH Adresy na platformie eNauczenie: Materiały dla Fotowoltaiki - Moodle ID: 15185 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=15185	
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Example issues/ example questions/ tasks being completed	<p>1. List the methods for increasing the efficiency of a silicon photovoltaic cell. Describe one of these methods in bullet points. 2. List thin-film cells and describe one of them. Why can't poly- or monocrystalline silicon cells be manufactured as thin-film cells? 3. The main parts of a silicon photovoltaic cell are the n-type layer (emitter) and the p-type layer (base). Explain why the emitter must be heavily doped and have a thickness of about 0.5 μm. 4. What materials, apart from silicon, are used in a silicon photovoltaic cell? What functions do these materials perform?</p>											
Work placement	Not applicable											

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