GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Photovoltaic cells, PG_00037316		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Physics of Organic and Perovskite Photovoltaic Structures -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Damian Głowienka	
	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	2.0	18.0	50

Subject objectives

The aim of the course is to familiarize students with the physical basics of the functioning of semiconductor photovoltaic cells.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U02] is able to analyse and solve complex and non-standard scientific and technical problems using appropriate analytical, computational, numerical, simulation or experimental methods.	The student is able to determine the theoretical limits of energy conversion efficiency for different photovoltaic cells and at different spectra of illuminating radiation	[SU2] Assessment of ability to analyse information
[K6_W04] has advanced knowledge of the principles of experimental design, experimental methods, measurement techniques and scientific equipment used in physics and related sciences, including their life cycle.	The student has advanced knowledge of experimental planning, measurement techniques and apparatus used for the characterization of solar cells, in particular J(V) measurements, determination of photovoltaic parameters, and assessment of the quality and repeatability of the obtained results.	[SW3] Assessment of knowledge contained in written work and projects

<table>
<tr><td>Subject contents</td><td>Course content – lecture

1.Introduction to semiconductor physics and solar cells

2. Solar cell efficiency

3. Characterisation of solar cells

4. Modeling of electrical and optical phenomena

5. Influence of transport and recombination mechanisms on operation of solar cell

6. Dye-sensitized solar cell

7. Organic solar cells

8. Perovskite solar cells

9. Tandem solar cells

Course content – laboratory
1. Construction of a setup for measuring currentvoltage (JV) characteristics

2. Measurement of the JV characteristics of solar cells

3. JV characteristics as a function of temperature and light intensity (irradiance)

4. Calculation of photovoltaic parameters from the obtained measurements</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basics of modern physics</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>reports</td><td>50.0%</td><td>30.0%</td></tr>
<tr><td>kolokwia</td><td>50.0%</td><td>70.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>Peter Würfel, Physics of Solar Cells, Wiley-VCH, Weinheim 2005.</td></tr>
<tr><td>Supplementary literature</td><td>P Würfel, U Würfel, Physics of solar cells - John Wiley & Sons 2016.</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. Define series and parallel resistance in a solar cell. What effect do they have on the JV characteristic at different illumination levels?

2. What are the recombination models in semiconductors?

3. What is the ShockleyQueisser efficiency limit, and how can it be exceeded?

4. What are the differences in the operating mechanisms of organic and perovskite solar cells?</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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