GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Photovoltaic systems, PG_00064055		
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	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Computational Chemical Physics -> 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. Justyna Lubośna	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	15.0	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	5.0	40.0	75

Subject objectives

- teach students how photovoltaic on-grid and stand-alone systems are constructed. Discuss main problems regarding the performance of such installations

- teach students how to design and properly locate PV systems, and how to assess their costs and cash flow

- teach students how to use the PVSOL premium software

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U06] is able to identify and assess risks, economic efficiency and the applicability of proposed engineering solutions, including critical evaluation taking into account non-technical factors such as ethical aspects.	The student can estimate the PV investment cost. Knows legal and other barriers (related to the functioning of the Energy Markets) hampering the calculation of profits and the payback period.	[SU1] Assessment of task fulfilment
[K6_W01] demonstrates an understanding of the civilisational significance of physics and its applications.	The student knows the physical, economic and ecological aspects of photovoltaic systems.	[SW3] Assessment of knowledge contained in written work and projects
[K6_K02] demonstrates readiness to use competences creatively for the benefit of society, including in an entrepreneurial manner.	Designs home PV installations and photovoltaic farms adapted to the requirements of the socio-economic environment.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents	Course content – lecture properties of solar radiation relevant for photovoltaic applications potential of photovoltaic installations in Poland, Europe and worldwide, with special emphasis on the potential of solar cell applications in Poland with respect to other EU countries solar panel testing conditions and their effect on photovoltaic parameters of these devices optimal solar panel tilt and azimuth angles depending on geographic location, season and climate increase in total power production resulting from the use of tracking systems of various types basic photovoltaic parameters of individual cells and photovoltaic modules problems related to the operation of solar batteries - analysis of current-voltage characteristics of cells, modules and PV panels - influence of external conditions (light intensity, temperature) - consequences of connecting cells into circuits of different configurations (solar modules, panels and arrays) - maximum power point tracking (MPPT) - selection of a PV technology proper for a given external load construction of PV modules - problems and methods of their elimination the issue of partial shading of a PV installation and its influence on MPPT other elements of on-grid photovoltaic systems and off-grid island installations: - batteries - types, functions, construction, principles of operation, lifetime - charge controllers - types, functions, charging methods and charging rates - inverters - types, functions, construction, operation principles - DC-DC converters - external loads - cabling - security and mounting of PV modules and panels - working conditions of PV installation components - examples of devices available on the market and their estimated costs proper selection of elements of stand-alone installations and on-grid systems

<table>
<tr><td></td><td>tools used to support the design process of photovoltaic power systems

design and cost-benefit analysis of on- and off-grid installations using appropriate software

Course content – project
Design of two solar cell systems: small scale solar installation and a PV power plant.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge on photovoltaic effect and operating principles of inorganic solar cells.</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>project of a PV system</td><td>50.0%</td><td>100.0%</td></tr>
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</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Arnulf Jäger-Waldau, Snapshot of photovoltaics, EPJ Photovoltaics 16, 22 (2025)

Bogdan Szymański, "Instalacje fotowoltaiczne", Geosystem, 2016

Shree Raj Shakya, Dinesh Kumar Sharma, Training Manual for Engineers on Solar PV System, 2011

J.M. Pearce and R. Andews, Engineering Photovoltaic Systems, 2010

Roger Messenger, Amir Abtahi, Photovoltaic Systems Engineering, CRC Press, 2010</td></tr>
<tr><td>Supplementary literature</td><td>James P. Dunlop, NJATC, Photovoltaic Systems</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Series and parallel connection of cells (modules, panels, arrays). Choice of modules suitable for the load. Maximum power point tracking. Module shading. Blocking and by-pass diodes.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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