



Subject card

Subject name and code	Photovoltaic systems, PG_00037320						
Field of study	Technical Physics						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2023/2024		
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	4	Language of instruction			Polish		
Semester of study	7	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Instytut Fizyki i Informatyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Justyna Szostak					
	Teachers	dr inż. Justyna Szostak					
Lesson types and methods of instruction	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	2.0		18.0		50
Subject objectives	<p>- teach students how photovoltaic on-grid and stand-alone systems are constructed. Discuss main problems regarding the performance of such installations</p> <p>- teach students how to design and properly locate PV systems, and how to assess their costs and cash flow</p> <p>- teach students how to use the PVSOL premium software</p>						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_U06	The student is able to 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.			[SU3] Assessment of ability to use knowledge gained from the subject		
	K6_W01	The student knows the physical, economic, and ecological aspects of photovoltaic systems.			[SW3] Assessment of knowledge contained in written work and projects		
	K6_W12	The student knows basic health and safety regulations in the field of PV systems.			[SW3] Assessment of knowledge contained in written work and projects		
	K6_U04	Uses professional software to design and simulate the performance of a PV system. Knows how to optimize the system on the basis of the results of the simulations.			[SU4] Assessment of ability to use methods and tools		
	K6_W08	The student knows the elements of PV systems. Knows how to design and test the performance of such an installation. Knows how to analyze collected data.			[SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<p>properties of solar radiation relevant for photovoltaic applications</p> <p>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</p> <p>solar panel testing conditions and their effect on photovoltaic parameters of these devices</p> <p>optimal solar panel tilt and azimuth angles depending on geographic location, season and climate</p> <p>increase in total power production resulting from the use of tracking systems of various types</p> <p>basic photovoltaic parameters of individual cells and photovoltaic modules</p> <p>problems related to the operation of solar batteries - analysis of current-voltage characteristics of cells, modules and PV panels</p> <ul style="list-style-type: none">- 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 <p>construction of PV modules - problems and methods of their elimination</p> <p>the issue of partial shading of a PV installation and its influence on MPPT</p> <p>other elements of on-grid photovoltaic systems and off-grid island installations:</p> <ul style="list-style-type: none">- 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 <p>proper selection of elements of stand-alone installations and on-grid systems</p> <p>tools used to support the design process of photovoltaic power systems</p>
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	design and cost-benefit analysis of on- and off-grid installations using appropriate software		
Prerequisites and co-requisites	Knowledge on photovoltaic effect and operating principles of inorganic solar cells.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	project of a PV system	50.0%	100.0%
Recommended reading	Basic literature	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	
	Supplementary literature	James P. Dunlop, NJATC, Photovoltaic Systems	
	eResources addresses	Adresy na platformie eNauczanie: Systemy fotowoltaiczne - Moodle ID: 34601 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34601	
Example issues/ example questions/ tasks being completed	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.		
Work placement	Not applicable		