

GDAŃSK UNIVERSITY

Subject card

Subject name and code	Solar Plants, PG_00042163								
Field of study	Power Engineering, Power Engineering, Power Engineering, Power Engineering, Power Engineering								
Date of commencement of studies	October 2020		Academic year of realisation of subject			2022/2023			
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 Polish or english			
Semester of study	6		ECTS credits			3.0			
Learning profile	general academic profile		Assessment form			exam			
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering								
Name and surname	Subject supervisor		dr inż. Piotr Kołodziejek						
of lecturer (lecturers)	Teachers								
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM	
	Number of study hours	15.0	0.0	15.0	15.0		0.0	45	
	E-learning hours included: 0.0								
	Lectures, laboratory exercises in the Control Systems in the Renewable Energy Sources Laboratory, visiting as guests in industrial organization representatives and implementing scientific research representatives in the field of solar power plants and radiation effects. Photovoltaic module design: AR coatings, textutring, reflectors, lifetime. PV modules modeling, operation issues: shading effect, DC/DC, DC/AC dedicated converters and control system synthesis. Efficiency, characteristics and equivalent circuit model parameter measurement and estimation.Maximum Power Point Tracking algorithms, extremal control strategies, local and global extremum identification.								
Learning activity and number of study hours	Learning activity	Participation in classes includ plan	n didactic ed in study	Participation in consultation hours		Self-study		SUM	
	Number of study hours	45		5.0		25.0		75	
Subject objectives	Theory of solar energy conversion. Characteristics of Sunlight and light sources. PN junction basics, materials, conduction, band gap, doping, intristic and equilibrium carrier concentration. Light absorption and electron-hole pair generation and recombination, total current calculation. Solar cells parametrs IV and PV curves, Voc, Isc, efficiency. Resistive, temperature I.								
Learning outcomes	Course outcome		Subject outcome			Method of verification			
	K6_W08		know control system basics, electrical circuit theory, digital signal basics and processing methods.			[SW3] Assessment of knowledge contained in written work and projects			
	K6_U04		can design, connect and start control system of solar power plant			[SU1] Assessment of task fulfilment			
	K6_W05		has structured knowledge concerning electrical measurements, their result documenting and measurement error uncertainity determination			[SW3] Assessment of knowledge contained in written work and projects			

Subject contents	Lecture: Theory of renewable energy conversion with particular emphasis on photovoltaics and wind energy						
	I. Solar energy conversion. Characteristics of Sunlight and light sources. PN junction basics, materials, conduction, band gap, doping, intristic and equilibrium carrier concentration. Light absorption and electronhole pair generation and recombination, total current calculation. Solar cells parametrs IV and PV curves, Voc, Isc, efficiency. Resistive, temperature and radiation effects. Photovoltaic module design issues: AR coatings, textutring, reflectors, lifetime. PV modules modeling, operation issues: shading effect, DC/DC, DC/AC dedicated converters and lcontrol system synthesis. Efficiency, characteristics and equivalent circuit model parameter measurement and estimation.						
	Maximum Power Point Tracking algorithms, extremal control strategies, local and global extremum identification, fault tolerant control.						
	Laboratory:						
	 Modeling and simulation of photovoltaic modules, I-V and P-V characteristics examination includir radiation and temerature effects, equivalent circuit parameters calculation, energy generation anal Hybrid maximum power point tracking algorithms for the PV shading effect and fault tolerant control Solartracker control algorithms. Sensorless maximum power point tracking.4 Solar energy resources measurement and analysis. Photovoltaic module characteristics measurement and efficeincy analysis and equivalent circuit parameters. DC/DC and DC/AC converter topologies for photovoltaics experimental tests. 						
Prerequisites and co-requisites	Basics of electrical circuits theory and physics.						
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade				
and criteria	Lecture test	50.0%	50.0%				
	Laboratory exercises reports	100.0%	50.0%				
Recommended reading	Basic literature	 Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- HaddHaddHaddad, Power Electronics for Renewable Energy Systems, Wiley 2014. IEEE articles. 					
	Supplementary literature	IEEE articles.					
	eResources addresses	Adresy na platformie eNauczanie:					
Example issues/ example questions/ tasks being completed	 Characteristics of the photovoltaic module including temperature, radiation, resistive and shading effects. Characteristics, structures of the maximum power point tracking control system algorithms. Maximum power point tracking algorithms for solar power plant control system. Hybrid extremal control systems application in the renewable energy sources. Sensorless and measurement-based solartracker control systems. Fault tolerant control of the solar power plant. Efficiency and quality of the solar power conversion. 						
Work placement	Field exercises						