



Subject card

Subject name and code	Control systems in renewable energy sources, PG_00044113						
Field of study	Electrical Engineering						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2025/2026		
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	3		Language of instruction		English		
Semester of study	5		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Electric Drives and Energy Conversion -> Faculty of Electrical and Control Engineering -> Wydział Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Piotr Kołodziejek				
	Teachers						
Lesson types and methods of instruction	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		5.0		15.0	50
Subject objectives	Wind farms, solar farms, constructions and applications. Innovative solutions in the field of renewable energy sources. Extreme control in wind and solar power plants. Simulation and physical models of solar and wind power plants. Examination of dynamic properties, wind turbine characteristics,examination of current-voltage characteristics and power of solar cells, determination of the optimal operating point cell, programming and working with MPPT algorithms implemented in microprocessor.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_W10		student explains solutions for optimal energy conversion in solar and wind power plants.		[SW1] Assessment of factual knowledge		
	K6_U10		student describes components of photovoltaic power plant and their functionalities.		[SU1] Assessment of task fulfilment		
	K6_K01		student describes elements of the wind turbine		[SK2] Assessment of progress of work		
	K6_K05		student explains rules for safety operation with wind turbine		[SK5] Assessment of ability to solve problems that arise in practice		
	K6_U09		student explains power converter topology for selected type of generator in the wind turbine.		[SU3] Assessment of ability to use knowledge gained from the subject		
Subject contents	Fundamentals of energy conversion in solar and wind power plants. Quantitative measurement and analysis of solar and wind energy resources. Measurement and analysis of characteristics of solar and wind power plants. Power electronics for solar and wind energy conversion. Solar and wind power plants modeling. Control systems in solar and wind power plants. Control system programming and analysis for physical models of solar and wind power plants. Control system for auxiliary systems in wind power plants. Hybrid Solartracker and partial-shading condition control systems. Innovative and conceptual ideas for solar, wind, tides and wave energy conversion.						
Prerequisites and co-requisites	1st level study program of Electrical Engineering						
Assessment methods and criteria	Subject passing criteria		Passing threshold		Percentage of the final grade		
	Lecture colloquium		50.0%		50.0%		
	Laboratory reports		50.0%		50.0%		

Recommended reading	Basic literature	[1] Bogalecka E., Krzeminski Z.: Bezczujnikowe sterowanie maszyną dwustronnie zasilaną pracującą jako generator w elektrowni wiatrowej, Zeszyty Naukowe Akademii Morskiej w Gdyni [2] Lubośny Z.: Elektrownie wiatrowe w systemie elektroenergetycznym. Gdańsk 2009 [3] Krzemiński Z.: Cyfrowe sterowanie maszynami asynchronicznymi, Gdańsk 2001 [4] Kołodziejek P.: Stany przejściowe przy sterowaniu maszyną dwustronnie zasilaną pracującą jako generator w farmie wiatrowej, MIS-6, Kościelisko 2010 [5] M. Włas, S. Galla, A. Kouzou, P. Kołodziejek "Analysis of an Energy Management System of a Small Plant Connected to the Rural Power System", Energies 2022 [6] Teaching materials of the Department of Electric Drive Automation [7] A. Fesenko, O. Matiushkin, O. Husev, D. Vinnikov, R. Strzelecki, P. Kołodziejek, "Design and experimental validation of a single-stage PV string inverter with optimal number of interleaved buck-boost cells" Energies 2021 [8] Materials available on the Internet (https://www.nrel.gov, https://www.fraunhofer.de/en.html)
	Supplementary literature	[1] Teaching materials of the Department of Automation of Electric Drive and Energy Conversion. [2] Scientific papers and reports from IEEE database.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Plotting the static characteristics of the modeled power plant: $C_p = f(I)$ and $P = f(w)$ for $w_w = \text{const}$. 2. Dynamic determinations: reaction to changes in wind value load power changes 3. Assess the quality of the optimal system (program model_3.mdl) 4. Determine the current-voltage and power-voltage characteristics of a photovoltaic cell for different values of insolation and temperature 5. For the given changes in insolation and temperature, the amount of electricity is determined for the voltage of 12V and the optimal voltage 6. Implementation of the MPPT control system for solar and wind power plants.	
Work placement	Not applicable	

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