GDAŃSK UNIVERSITY OF TECHNOLOGY

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 2024	Academic year of realisation of subject	2026/2027
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Kołodziejek	
	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

eNauczanie source address: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=41962

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, progrmming and workking with MPPT algorithms implemented in microprocessor.Energy storage systems. Energy Management Systems (EMS).

Learning outcomes

Course outcome	Subject outcome	Method of verification
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
K6_K05	student explains rules for safety operation with wind turbine	[SK5] Assessment of ability to solve problems that arise in practice
K6_K01	student describes elements of the wind turbine	[SK2] Assessment of progress of work
K6_U10	student describes components of photovoltaic power plant and their funcionalities.	[SU1] Assessment of task fulfilment
K6_W10	student explains solutions for optimal energy conversion in solar and wind power plants.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture 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. Enegy storage systems, Energy Management Systems Course content – laboratory **Exercise 1** Modeling the characteristics of photovoltaic modules and calculating energy production assuming extremal control. **Exercise 2** Modeling of a wind power plant characteristics, dynamics, and control systems. **Exercise 3** Implementation and analysis of solar power plant control algorithms under partial shading conditions. **Exercise 4** Experimental determination of wind power plant characteristics and analysis of control systems. **Exercise 5** Experimental determination of the characteristics and key parameters of photovoltaic panels. **Exercise 6** Investigation of wind and solar energy resources. **Exercise 7** Tracking systems in solar power plants.	
Prerequisites and co-requisites	1st level study program of Electrical Engineering WEiA GUT	
Assessment methods and criteria	see table below	

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	50.0%	50.0%
Lecture colloquium	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, "

	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	
Example issues/ example questions/ tasks being completed	1. Plotting the static characteristics of the modeled power plant: Cp = f (lambda) and P = f (wr) for Vw = 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.	
Practical activites within the subject	Not applicable	