

GDAŃSK UNIVERSITY

Subject card

Subject name and code	Control Systems in Renewable Power Engineering, PG_00038128								
Field of study	Automation, Robotics and Control Systems								
Date of commencement of studies	October 2020		Academic year of realisation of subject			2022/2023			
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			Polish			
Semester of study	6		ECTS credits			3.0			
Learning profile	general academic profile		Assessment form			assessment			
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering								
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Elżbieta Bogalecka						
	Teachers		dr hab. inż. Elżbieta Bogalecka						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM	
	Number of study hours	30.0	0.0	15.0	0.0		0.0	45	
	E-learning hours included: 0.0								
	Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=21118								
Learning activity and number of study hours	Learning activity Participation ir classes include plan		I didactic Participation in ed in study consultation hours		Self-study SL		SUM		
	Number of study hours	45		4.0		26.0		75	
Subject objectives	The aim of the course is to learn the design, operation, control methods and tools for renewable energy sources: wind power plants and wind farms, photovoltaicplants, hybrid power systems with RES and energy storage								
Learning outcomes	Course outcome		Subject outcome			Method of verification			
	K6_K05		student understands the impact of renewable energy sources on the energy balance and is able to assess the economic efficiency of using these sources. Can assess the energy potential of renewables.			[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work			
	K6_W07		the student is able to justify the need and structure of the RES control system. Can determine the type of control system.			[SW1] Assessment of factual knowledge			
	K6_U05		the student is able to build and run a measuring system and examine the properties of the control object together with the regulation system. He can use simulation tools to test the properties of RES control systems			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools			

Subject contents	LECTURE Characteristics of the renewable energy sources with particular focus to energy sources: wind, solar constructions and use. Issues of wind power energy processing: wind energy conversion principles, the basic aerodynamic issues, wind power turbine construction. Wind turbine power control, separation of air jets, pitch control of angle blades. Generators and power processing systems. Wind turbine control systems for the fixed and variable speed generators. The hierarchical structure of the wind power plant control system rules. Optimal control of the systems. MPPT algorithms. Wind farms: grid connection issues, the additional physical phenomena, influence to the power system, its stability and power quality. Central control of the wind park. Solar power plants: energy conversion phenomenon, photovoltaic modules constructions, manufacturing and basic properties of photovoltaic cells. Static and dynamic properties of the PV modules. Model of PV cells and determination of the equivalent circuit parameters. Photovoltaic Systems: grid integtation, islanding, and hybrid systems. Solar energy conversion systems. Control of solar panels. Optimal orientation and sun tracking systems. Optimal operating point (maximum power), batteries and Maximal Power Point Control Algorithms (MPP). Electrical energy storing: batteries, supercapacitors, kinetic energy accumulation systems, fuel cells. Distributed generation. The renewable energy system impact on the grid. Micronetworks with renewable energy sources LABORATORY EXERCISES Simulation and physical models of solar and wind power systems. Physical models of the sun location and tracking systems. Investigation of the dynamic characteristics of the wind turbines, quality of control system, testing decoupled passive and active power control in double fed generator, a study of external disturbance influence to wind turbine operation, data measurement , surveys of sun and wind, analysis of voltage-current characteristics and photovoltaic power, determination of the optima						
Prerequisites and co-requisites	Knowledge in Electric Drives, Powe	r Electronics, Control Systems Theor	y, Physics, Mechanics				
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade				
and criteria	colloquium of the lecture	50.0%	50.0%				
	Laboratory reports	60.0%	50.0%				
Recommended reading	Basic literature	lecture materials, laboratory instructions and simulation programs on the eNauczanie platform. https://enauczanie.pg.edu.pl/moodle/course/view.php?id=21118					
	Supplementary literature	None					
	eResources addresses	Adresv na platformie eNauczanie:					
Example issues/ example questions/ tasks being completed	 is/ 1. Explain the principle of MPPT algorithm for wind power plant. ions/ impleted 						
	2. How is the angular velocity of the wind power plant limited at V> Vn?						
	 a. Explain the basic topologies of the solar power plants? 4. what are the effects of shadow in the solar power plants ? 						
Work placement	Not applicable						