GDAŃSK UNIVERSITY OF TECHNOLOGY

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 2022		Academic year of realisation of subject		2024/2025	
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					

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	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	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_W07] has basic knowledge related to control and automation systems	the student knows the principles of operation of electric renewable energy sources and ways of controlling them. The student knows basics of energy resources management in hybrid systems and separate networks.	[SW1] Assessment of factual knowledge
	K6_U05	the student, using the knowledge acquired in the course, is able to properly perform the task using simulation tools i technical devices. the student is able to process and analyze measurement results and present them in the form of a report.	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
	[K6_K05] can think and act in an entrepreneurial way	the student is able to plan the method and sequence of activities to perform a laboratory task. The student is able to deal with real technical problems.	[SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work [SK1] Assessment of group work skills
	[K6_U05] can use analytical and simulation methods to solve tasks in the field of automation and robotics and use various techniques to carry out engineering tasks related to automation and robotics devices and systems	the student, using the knowledge acquired in the course, is able to properly perform the task using simulation tools i technical devices. the student is able to process and analyze measurement results and present them in the form of a report.	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment

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, 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 optimal operating point of PV cells.
Prerequisites and co-requisites	Knowledge in Electric Drives, Power Electronics, Control Systems Theory, Physics, Mechanics

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	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	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Explain the principle of MPPT algorithm for wind power plant. 2. How is the angular velocity of the wind power plant limited at V> Vn? 3. 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