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 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	Project	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 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_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

<table>
<tr><td>Subject contents</td><td>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.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge in Electric Drives, Power Electronics, Control Systems Theory, Physics, Mechanics</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>colloquium of the lecture</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Laboratory reports</td><td>60.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
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<tr><td>Basic literature</td><td>lecture materials, laboratory instructions and simulation programs on the eNauczanie platform.

https://enauczanie.pg.edu.pl/moodle/course/view.php?id=21118</td></tr>
<tr><td>Supplementary literature</td><td>None</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>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 ?</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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