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 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	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_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	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work [SK5] Assessment of ability to solve problems that arise in practice
[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 the basics of energy management in hybrid systems and separate networks	[SW1] Assessment of factual knowledge
[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 and 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 [SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject

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