GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Intelligent power distribution systems, PG_00072596		
Field of study	Electrical Engineering, Automation, Robotics and Control Systems		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Electrical Power Engineering -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Krzysztof Dobrzyński	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	15.0	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	5.0	25.0	75

Subject objectives

The aim of this course is to introduce students to current issues in the operation of electricity distribution systems related to the development of selected technological areas, such as renewable energy sources, electromobility, energy storage, and heat pumps. Students will introduce with selected environments for analyzing and visualizing the operation of distribution systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W05] has detailed knowledge of the regulatory processes in the electricity system electricity system, electricity safety and electricity safety automation, is familiar with technologies high voltage	Analyzes the operation of the distribution system, selects and evaluates the operation of control systems	[SW3] Assessment of knowledge contained in written work and projects
[K7_W02] has an in-depth and structured knowledge of electrical measurements electrical measurements, the methods and equipment used for electrical measurements of non-electrical quantities, he/she knows the principles of testing operation tests of electrical equipment, has a structured knowledge of electricity quality issues	The student knows the principles of operation of devices involved in the regulation of voltage and reactive power in the power system.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U03] is able to obtain information from literature, databases and other sources, also in English, draw conclusions, formulate and fully justify opinions. substantiate opinions; is able to identify directions for further learning and implement the process of self-education	Critically evaluates and compares various technical solutions for voltage and flow control in distribution systems, formulates opinions on them and justifies them logically and based on acquired data.	[SU1] Assessment of task fulfilment
[K7_W03] has an extended and deepened knowledge of the field related to electrical power systems and electrical equipment	The student has advanced knowledge of the impact of changes in various technologies on the functioning of electricity distribution systems.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

Course content – lecture
The role of electricity distribution systems in the energy transition. The development of technologies that have or may in the future have a significant impact on the operation of distribution systems, along with an analysis of this impact. Solutions used in modern distribution systems that improve their operation and management. Criteria and limitations of voltage control in power systems. Technical constraints and standards. Regulation criteria. Regulators for individual devices: generators, transformers, capacitor banks, reactors, compensators, and energy storage. The role of wind farms, photovoltaic farms, and energy storage in control processes.

Course content – laboratory
Students will be introduced to current issues in the operation of distribution systems. This includes the impact of renewable energy sources, heat pumps, electromobility, and energy storage on the operation and control of the distribution network. Analyses will be conducted using DIgSILENT's PowerFactory software, which models the operation of sample distribution networks with varying levels of these facilities, taking into account regulatory processes. The aim of the analyses will be to identify voltage problems in the network and explore ways to mitigate them.

Course content – project
Students will be introduced to the analysis and visualization of distribution network operating parameters relevant to management, both during normal and emergency states. Analyses will integrate measurement/ network data with spatial data of the network infrastructure, utilizing GIS systems to model, monitor, and visualize network status, as well as the location and impact of operational events. Analyses will be based on Esri's ArcGIS software, used by distribution system operators, among others, while also utilizing the PowerFactory computing environment.

Prerequisites and co-requisites

Basic knowledge of electrical engineering

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture test	50.0%	20.0%
Project report	50.0%	40.0%
Lab report	50.0%	40.0%

Recommended reading

Basic literature

[1] Zajczyk R.: Regulacja napięcia i mocy biernej w systemie elektroenergetycznym. Wer_2018. Wydanie elektroniczne (pdf).

[2] Machowski J.: Regulacja i stabilność systemu elektroenergetycznego Oficyna Wydawnicza Politechniki Warszawskiej Warszawa 2007

[3] Billewicz K.: Inteligentne sieci elektroenergetyczne - wybrane aspekty, 2016.

[4] Prawo energetyczne. Rozporządzenie w sprawie zasad funkcjonowania systemu pomiarowego, 2024.

[5] Instrukcja Ruchu i Eksploatacji Sieci Dystrybucyjnej

[6] Ustawa o odnawialnych źródłach energii z dnia 20 lutego 2015 r.

Supplementary literature

[1] Kacejko P., Pijarski P., Podstawy elektroenergetyki, PWN 2024

[2] Zaktualizowane wymogi ogólnego stosowania wynikające z Rozporządzenia Komisji (UE) 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającego kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci (NC RfG). PSE, Konstancin - Jeziorna, dn. 01.02.2024

[3] Zbiór nastaw i kryteriów zabezpieczeniowych oraz parametrów konfiguracyjnych charakterystyk regulacyjnych dla MWE typu A i B. PTPiREE, 01.10.2024

eResources addresses

Example issues/ example questions/ tasks being completed

The impact of connecting prosumer PV systems on voltage levels in the LV grid

The impact of electricity storage location on voltage levels in the LV and MV grids

Selection of the location of a regulating transformer in the MV or LV grid

Practical activites within the subject

Not applicable

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