



Subject card

Subject name and code	Voltage Regulation of the Power System, PG_00069143						
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 hab. inż. Jacek Klucznik				
	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 student recognises the voltage control processes in the power system with the specificity of high, medium and low voltage networks. The student is acquainted with voltage control devices and systems, and how to model, analyse and design them.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[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 masters the principles of equipment involved in the control 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	Students will be able to critically evaluate and compare various technical solutions in the field of voltage control, formulate opinions on them and justify them logically and based on acquired data.			[SU1] Assessment of task fulfilment		
	[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	Students will analyse the operation of the electrical grid, select and evaluate the operation of voltage control systems			[SW3] Assessment of knowledge contained in written work and projects		
	[K7_U02] is able to prepare and deliver a short oral presentation on a selected technical topic	Students will be able to prepare and present orally, in a concise and substantive manner, a selected technical topic related to voltage regulation in the power system, using relevant literature sources and multimedia tools.			[SU5] Assessment of ability to present the results of task		

Subject contents	<p>Course content – lecture</p> <p>Criteria and constraints for voltage regulation in power systems. Technical constraints, standards. Control criteria. Algorithms and control system structure. Algorithms of area regulation. Rational structure of the control system for voltage levels and reactive power distribution. Controllers of individual devices: generators, transformers, shunt reactors and capacitor banks, compensators. Constructions, algorithms, selection of settings. Group regulators of generation nodes ARNE and network nodes ARST. Master regulators. Determination of setpoints for group regulation. Involvement of wind and photovoltaic farms in voltage regulation. Voltage problems in MV and LV networks related to the connection of renewable sources and ways to mitigate them.</p>														
	<p>Course content – laboratory</p> <p>Analysis of the voltage and reactive power control system of a synchronous generator. Development of a generator model with an automatic voltage regulator (AVR) in the PowerFactory environment. Analysis of the $U=f(Q)$ characteristic. Investigation of the impact of regulator settings (K_p, K_i). Comparison of different types of algorithms (P, PI, droop control).</p> <p>Analysis of the control system of a transformer with a tap changer. Development of a model containing lines and a transformer in PowerFactory. Simulation of voltage regulation during load changes. Selection of parameters: dead band, delay time, tap step.</p>														
	<p>Course content – project</p> <p>Development of a PV farm or wind farm model in PowerFactory. Selection of reactive power compensation devices in accordance with legal requirements. Simulation of various operating modes: $Q = \text{const}$, $\cos\phi = \text{const}$, $Q=f(U)$, at various levels of active power generation. Identification of voltage problems and ways to mitigate them.</p>														
Prerequisites and co-requisites	Passed subjects Electrical Circuits and Electrical Power Engineering.														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Project presentation</td> <td>50.0%</td> <td>40.0%</td> </tr> <tr> <td>Evaluation of laboratory report</td> <td>50.0%</td> <td>40.0%</td> </tr> <tr> <td>Knowledge test</td> <td>50.0%</td> <td>20.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Project presentation	50.0%	40.0%	Evaluation of laboratory report	50.0%	40.0%	Knowledge test	50.0%	20.0%
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Recommended reading	Basic literature	[1] Kundur P., Power System Stability and Control. McGraw-Hill, Inc. 1994.													
	Supplementary literature	[1] Turan Gonen, Electrical Power Transmission System Engineering: Analysis and Design, Third Edition, CRC Press, 2014 [2] J. D. Glover, M. S. Sarma, T.J. Overbye, Power System Analysis & Design, Cengage Learning, 2011													
	eResources addresses														
Example issues/ example questions/ tasks being completed	<p>Performing the selection of synchronous generator control system settings.</p> <p>Analysing the operation of a HV/SN transformer controller</p> <p>Discussing types and methods of controlling reactive power sources in the power system</p> <p>Selecting the location of a regulating transformer in the MV network</p>														
Practical activities within the subject	Not applicable														

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