



Subject card

Subject name and code	Disturbances in Electrical Power Systems, PG_00038475						
Field of study	Electrical Engineering						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2023/2024		
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	1		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Marek Olesz				
	Teachers		dr hab. inż. Marek Olesz				
			dr inż. Daniel Kowalak				
			dr hab. inż. Jacek Klucznik				
			dr hab. inż. Robert Kowalak				
			dr inż. Piotr Leśniak				
		dr inż. Jacek Katarzyński					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	15.0	0.0	0.0	60
	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	60		10.0		30.0	100
Subject objectives	Acquiring knowledge of the causes, and consequences of disturbances in electrical power systems. Acquiring skills for calculating currents and voltages transients during lightning phenomena, switching operations and short circuits in electrical power systems. Understanding the mechanisms and effects of disturbance on the selected electrical and electronic devices and methods of selection and tests of safety devices, especially surge arresters.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_W02		describes the quality parameters of electricity and determines the source of disturbances		[SW1] Assessment of factual knowledge		
	K7_U08		it measures disturbances with appropriate equipment and draws appropriate conclusions based on measurements		[SU4] Assessment of ability to use methods and tools		
	K7_K02		appreciates the importance of independent extension of knowledge in the field of electromagnetic compatibility		[SK2] Assessment of progress of work		

Subject contents	<p>Lecture: Short-circuits in low, medium and high voltage network. Influence of the type of neutral point earthing on the level of short-circuit currents and overvoltages. Currents of metallic and fault arc short-circuits, nearby and distant short-circuits. Parameters of fault arc. Influence of arc resistance on short-circuit currents. Fault arc resistance of transformer station and switchboards (aerial isolation and GIS). Fault arc effects limitation. Behaviour of switches and apparatuses under disturbance conditions.</p> <p>Characteristics of voltage and time surges. Waveforms in long transmission lines. Propagation of electromagnetic waveforms in overhead and cable lines. Electric strength of long air insulating clearances. Critical time of stroke. Systems of operation of power networks and their impact on the level of overvoltages. Coordination of insulation and selection of test voltages. Limiting the level of overvoltages in power systems - lightning protection and overvoltage protection. Surge arresters - production technology, properties, parameters. Selection of surge arresters and their location. Diagnostics of surge arresters.</p> <p>Devices used to registration of disturbances. Normative requirements regarding the power quality parameters. Influence of power supply parameters on the operation of electric energy receivers. Ways to improve the quality parameters of the supply voltage. Electromagnetic compatibility. Requirements for the immunity of devices to interference. Permitted levels of emissivity of devices. Permissible levels of electric and magnetic fields in the vicinity of electrical power equipment.</p> <p>Classes:</p> <p>Short-circuit calculations using the asymmetric components method in HV and MV networks. Calculations of waveforms in long transmission lines. Analysis of waveforms in systems with sparks and varistor surge arresters. Selection of parameters of surge arresters in MV and HV networks. Calculation of the allowable distances between arresters and protected devices.</p> <p>Laboratory exercises</p> <p>Overvoltage propagation in power systems. Effect of the method of grounding the neutral point on overvoltage level. Distribution of surge arresters in the power system. Magnetic and electric field measurements. Transient state analysis during switching operations. Emission of higher harmonics by nonlinear receivers.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercise	60.0%	25.0%
	Written exam	60.0%	50.0%
	Written tests	60.0%	25.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Maksymiuk J.: Aparaty elektryczne. WNT, Warszawa, 1992. 2. Ciok Z., Maksymiuk J., Pochanke Z., Zdanowicz L.: Badanie urządzeń energoelektrycznych. WNT, Warszawa 1992. 3. Markiewicz H.: Urządzenia elektroenergetyczne. WNT, Warszawa 2008. 4. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych. WNT Warszawa 2002. 5. Flisowski Z. Technika wysokich napięć, WNT, Warszawa, 1988 6. Kosztaluk R. I inni: Technika badań wysokonapięciowych, WNT, Warszawa, 1985 	
	Supplementary literature	<ol style="list-style-type: none"> 1. D. Duda, Z. Gacek, Przepięcia w sieciach elektroenergetycznych i ochrona przed przepięciami, Gliwice 2015 2. K. Żmuda, Elektroenergetyczne układy przesyłowe i rozdzielcze. Wybrane zagadnienia z przykładami, Gliwice 2012 	
	eResources addresses	Adresy na platformie eNauczanie:	

Example issues/ example questions/ tasks being completed	1 Discuss the phenomenon of back flashover in the overhead line insulation. 2 Discuss the mechanism of the lightning. 3 Impact stresses in isolation. 4 Discuss the phenomena occurring during switching off inductive currents. 5 Discuss the class A and class B instruments for the measurement of electric energy quality. 6. Protection of the isolation of capacitors. 7. Surge wave in the node connecting the cable line. 8 Switching on the capacitance (capacitor banks, unloaded lines, cables). 9 Construction and selection of metal oxide surge arresters. 10 Distribution of currents during short circuits in networks with isolated neutral point. 11. Deformation of load currents of the transformers. 12 Insulation coordination. 13 Arcs in enclosed switchgear.
Work placement	Not applicable