



Subject card

Subject name and code	Disturbances in Electrical Power Systems, PG_00038475						
Field of study	Electrical Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2022/2023		
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. Robert Kowalak dr inż. Piotr Leśniak dr inż. Jacek Katarzyński dr hab. inż. Marek Olesz dr inż. Daniel Kowalak dr hab. inż. Jacek Klucznik					
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_K02	appreciates the importance of independent extension of knowledge in the field of electromagnetic compatibility			[SK2] Assessment of progress of work		
	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_W02	describes the quality parameters of electricity and determines the source of disturbances			[SW1] Assessment of factual knowledge		

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	<table border="1"> <thead> <tr> <th data-bbox="453 1341 794 1370">Subject passing criteria</th> <th data-bbox="799 1341 1141 1370">Passing threshold</th> <th data-bbox="1145 1341 1485 1370">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 1377 794 1406">Written tests</td> <td data-bbox="799 1377 1141 1406">60.0%</td> <td data-bbox="1145 1377 1485 1406">25.0%</td> </tr> <tr> <td data-bbox="453 1413 794 1442">Written exam</td> <td data-bbox="799 1413 1141 1442">60.0%</td> <td data-bbox="1145 1413 1485 1442">50.0%</td> </tr> <tr> <td data-bbox="453 1449 794 1478">Practical exercise</td> <td data-bbox="799 1449 1141 1478">60.0%</td> <td data-bbox="1145 1449 1485 1478">25.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Written tests	60.0%	25.0%	Written exam	60.0%	50.0%	Practical exercise	60.0%	25.0%
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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