



Subject card

Subject name and code	Testing and Exploitation of Electric Power Equipment, PG_00038363						
Field of study	Electrical Engineering						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2022/2023		
Education level	second-cycle studies	Subject group			Optional subject group Subject group related to scientific research in the field of study		
Mode of study	Part-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 Mechatronics and High Voltage Engineering -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Daniel Kowalak					
	Teachers	dr inż. Daniel Kowalak					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	10.0	0.0	0.0	10
	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	10	6.0		59.0		75
Subject objectives	Students are introduced with the requirements, procedures and methods of testing electrical devices and apparatus in accordance with applicable standards and regulations.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K7_K03	Defines the basic types of exploational testing electrical devices. Explains the method realizations investigation on basic at present obligatory norms and regulations.			[SK5] Assessment of ability to solve problems that arise in practice		
	K7_U08	Performs investigations analysed devices. Interpress test results and draws conclusions on the tests. Appreciates the ability to use measuring instruments. Joins knowledge from various fields.			[SU4] Assessment of ability to use methods and tools		
	K7_W02	Identifies the type of electrical apparatus and electrical devices and their rating dates. Plans and prepares research program of new and exploational apparatus and electrical devices. Calculates the basic parameters of testing circuits. Designates accuracy class of current and voltage transformers.			[SW3] Assessment of knowledge contained in written work and projects		
Subject contents	Principle of guidance of laboratory investigations electric apparatuses and electrical devices. High-current testing and switching capacity of electrical apparatus and electrical devices. 3 phase and 1 phase tests. Chosen the exploational investigations of transformers and current transformers and voltage transformers. Calculating the basic parameters of testing circuit. Investigations short-circuit (making and breaking) capacity of electrical apparatus and power systems devices. Selection of parameters of measurement systems. The use of digital technology in high-current tests. Measurement errors in the current and voltage transformers. The research limiting capacity of medium voltage switching devices. Set short-circuit strength, low voltage switches: switch-fuse. Studies the characteristics of overcurrent circuit breakers.						
Prerequisites and co-requisites	Knowledge of the structure and principles of operation of electrical apparatus and electrical devices. Ability to use the standards norms. Knowledge of the items, Electric Circuits, High Voltage Engineering, Electrical Metrology, Electrical Power Engineering, Electrical Devices.						

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	60.0%	60.0%
	Reports of laboratory exercises	60.0%	40.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Boryń H., Kowalak D., Olesz M.: Laboratorium przekładników indukcyjnych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2011 2. Ciok Z.: Procesy łączeniowe w układach elektroenergetycznych, WNT, Warszawa 1983. 3. Ciok Z., Maksymiuk J., Pochanke Z., Zdanowicz L.: Badanie urządzeń energoelektrycznych, WNT, Warszawa 1992. 4. Maksymiuk J., Pochanke Z.: Obliczenia i badania diagnostyczne aparatury rozdzielczej, WNT, Warszawa 2001 5. Wiszniewski A.: Przekładniki w elektroenergetyce, WNT, Warszawa 1992 	
	Supplementary literature	<ol style="list-style-type: none"> 1. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych, WNT, Warszawa, 2002 2. Maksymiuk J.: Aparaty elektryczne w pytaniach i odpowiedziach, WNT, Warszawa 1997 3. Markiewicz H.: Urządzenia elektroenergetyczne. WNT, Warszawa 2008 4. Koszmider A., Olak J., Piotrowski Z.: Przekładniki prądowe, WNT, Warszawa 1985 5. Chwaleba A., Poiński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979 	
	eResources addresses	Adresy na platformie eNauczanie: BADANIA I EKSPLOATACJA URZĄDZEŃ ELEKTROENERGETYCZNYCH [Niestacjonarne][2022/23] - Moodle ID: 28548 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=28548	

The measurement errors of the current transformer.

1. Present basic types of construction currents and voltages transformers.
2. Why current transformer should work in conditions similar to a short-circuit?
3. What is the current error and phase displacement of current transformer?
4. What is accuracy class of current transformer?
5. In what ranges of currents and burdens the current transformer should maintain its accuracy class?
6. Explain ways to reduce errors in current transformer.

The measurement errors of the voltage transformer.

1. Provide basic constructional types of voltage transformers due to the installation site and the type of the measured voltage.
2. Why the voltage transformer should work in conditions similar to idling?
3. What is the voltage error and phase displacement of voltage transformer?
4. What is accuracy class of voltage transformer?
5. In what ranges of voltages and burdens the voltage transformer should maintain its accuracy class?
6. Explain ways to reduce errors in voltage transformer

The study of breaking current tests of medium voltage switch

1. What is the switch? List the basic requirements to be met by switch.
2. Explain the basic differences between the switch and the switch-disconnector.
3. Discuss cooperation switch-fuse.
4. Specify the basic scope of the research type that should pass MV switch.
5. Discuss preparation for circuit testing of switch.
6. Introduce requirements for mainly active load circuit in breaking test of switch.
7. Introduce requirements for value and shape of the test voltage and test current in breaking test of switch.
8. What requirements must meet the switch, that the breaking test has passed?

The research the time-current characteristics of overcurrent circuit breaker

1. Draw and explain the time-current characteristics of overcurrent circuit breaker type B? For what purpose is it used? Replace destiny overcurrent circuit breaker with characteristic type B?
2. Draw and explain the time-current characteristics of overcurrent circuit breaker type C? For what purpose is it used? Replace destiny overcurrent circuit breaker with characteristic type C?
3. Draw and explain the time-current characteristics of overcurrent circuit breaker type D? For what purpose is it used? Replace destiny overcurrent circuit breaker with characteristic type D?
4. Describe the principle of operation of overload release in overcurrent circuit breaker.
5. Describe the principle of operation of instantaneous release in overcurrent circuit breaker.
6. Explain the mechanism of arc extinguishing and cut off the current in the overcurrent circuit breaker.

The short-circuit tests of MV disconnector and earthing switch.

1. What is the rated peak withstand current and rated short-time withstand current of disconnector and earthing switch?
2. What the electrodynamic interactions occur in the disconnector during flow short-circuit current?
3. What the thermal stresses occur in the disconnector during flow short-circuit current?
4. Describe procedure for making short-circuit tests of disconnector or earthing switch.
5. What requirements must be met by disconnecting and earthing switch, which short-circuit tests were passed.

The voltage tests of voltage and current transformers

1. What electrical stress acting on the isolation voltage and current transformers?
2. Discuss the influence of precipitation on the strength of electric voltage and current transformers.
3. Present electrical requirements imposed current and voltage transformers.
4. How to check the electrical strength of current and voltage transformers with power-frequency voltage tests?
5. How to check the electrical strength of current and voltage transformers with lightning impulse voltage tests?

The study of electrodynamic interactions in busbars systems

1. Explain to the effects of flow short-circuit current through the current circuit of an electrical device.
2. What factors affect the value of the maximum electrodynamic force, which occurs in the circuit during short-circuit current?
3. What factors affect the value of mechanical tenses, which occurs in the circuit during short-circuit current?
4. Is the position of busbar affects on the electrodynamic strength of the busbars system? Justify your answer.
5. What factors influence the natural frequency of the busbar?
6. Is the number of supports of busbar influences the mechanical stress? Justify your answer.

The practical performance tests power transformers

1. Describe the construction and the principle of operation of power transformer.

	<ol style="list-style-type: none">2. Windings connections in power transformers. What are the objectives and designation of different vector groups connections in power transformers?3. Draw the selected configuration of the power transformer winding connections and its vector diagram (Yy0, Dy5, Yzn5)4. Measurements of the insulation resistance of power transformer. Insulation resistance measurement indicators.5. What is percentage of the power transformer non-load current? What determines of the value of the rated current?
Work placement	Not applicable