



## Subject card

Subject name and code	Testing and Exploitation of Electric Power Equipment, PG_00038490						
Field of study	Electrical Engineering						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		Polish		
Semester of study	3		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						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	30.0	0.0	0.0	30
	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	30		5.0		40.0	75
Subject objectives	Students are introduced with the requirements, procedures and methods of testing electrical devices and apparatus in accordance with current standards and regulations.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_W02		Identifies the type of apparatus and devices and their rated parameters. Plans and develops a programme of the tests new and exploited apparatuses and devices. Calculates the basic parameters of test circuits. Determines the accuracy classes of current and voltage transformers.		[SW3] Assessment of knowledge contained in written work and projects		
	K7_K03		Defines the basic types of operational testing of electrical power devices. Explains how to perform tests on the basis of current standards and regulations.		[SK5] Assessment of ability to solve problems that arise in practice		
	K7_U08		Performs tests of the analyzed devices. Interprets the results of tests and draws conclusions concerning the conducted tests. Appreciates the ability to use measuring instruments. Combines knowledge from different fields.		[SU4] Assessment of ability to use methods and tools		
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. Analysis of transient states occurring during switching operations related to switching of inductive and capacitive circuits. 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		
	Reports of laboratory exercises		60.0%		40.0%		
	Midterm colloquium		60.0%		60.0%		

Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. Boryń H., Kowalak D., Olesz M.: Laboratorium przekładników indukcyjnych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2011</li> <li>2. Ciok Z.: Procesy łączeniowe w układach elektroenergetycznych, WNT, Warszawa 1983.</li> <li>3. Ciok Z., Maksymiuk J., Pochanke Z., Zdanowicz L.: Badanie urządzeń energoelektrycznych, WNT, Warszawa 1992.</li> <li>4. Maksymiuk J., Pochanke Z.: Obliczenia i badania diagnostyczne aparatury rozdzielczej, WNT, Warszawa 2001</li> <li>5. Wiszniewski A.: Przekładniki w elektroenergetyce, WNT, Warszawa 1992</li> </ol>
	Supplementary literature	<ol style="list-style-type: none"> <li>1. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych, WNT, Warszawa, 2002</li> <li>2. Maksymiuk J.: Aparaty elektryczne w pytaniach i odpowiedziach, WNT, Warszawa 1997</li> <li>3. Markiewicz H.: Urządzenia elektroenergetyczne. WNT, Warszawa 2008</li> <li>4. Koszmider A., Olak J., Piotrowski Z.: Przekładniki prądowe, WNT, Warszawa 1985</li> <li>5. Chwaleba A., Poiński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979</li> </ol>
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/  
example questions/  
tasks being completed

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 processes occurring during the switching operations of transformers.

1. Discuss the processes that take place when switching on an idling transformer.
2. Discuss the processes that occur when switching off low inductive currents (e.g. unloaded transformer, induction motor).
3. Discuss the effects of overloads occurring when switching on an unladen transformer.
4. Discuss the case of repeated arc ignitions when switching off the transformer at idle.
5. Discuss the effects of overvoltages occurring when switching off the transformer when it is idle. How can the surge mechanism be counteracted?

The processes occurring during the switching operations of capacitor battery.

1. Discuss the switching processes that occur when connecting the capacitor banks.
2. Discuss the processes that occur when turning off the capacitor battery.
3. Discuss the effects of switching on a capacitor bank.
4. Discuss the effects of switching off a capacitor bank. How to counteract the surge mechanism.
5. Discuss the case of re-ignition of the arc when switching off a capacitor bank.

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.

	<p>Tests of the switching capacity of installation overcurrent circuit breakers</p> <ol style="list-style-type: none"> <li>1. Explain what is the basic function and role of the circuit breakers ?</li> <li>2. Explain what kind of exposure occurs in the device when switching on interference currents?</li> <li>3. Explain what are the exposures of the apparatus during the interruption of disturbance currents?</li> <li>4. Explain which switching operations result in the greatest exposure?</li> <li>5. Describe the mechanism for extinguishing the arc in chambers made of metal deionizing plates.</li> <li>6. What are the requirements for apparatus designed for switching capability tests?</li> <li>7. Describe how to perform connectivity testing for single-pole devices</li> <li>8. What requirements must be met by a circuit breaker that has passed the short-circuit capacity tests.</li> </ol>
Work placement	Not applicable