



Subject card

Subject name and code	High voltage engineering, PG_00058360						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2024/2025		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	3	Language of instruction			Polish		
Semester of study	6	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Katedra Elektrotechniki -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Marek Olesz				
	Teachers		dr inż. Daniel Kowalak dr hab. inż. Marek Olesz				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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	2.0		18.0	50	
Subject objectives	Knowledge of phenomena occurring in high-voltage insulation systems using gaseous, liquid and solid dielectrics. Introduction to lightning and surge protection. Mastering measurement procedures related to performing voltage tests on insulation systems.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W02] has basic knowledge of physics and chemistry including electrostatics, electromagnetism, electrodynamics, wave motion, acoustics, mechanics, thermodynamics, optics, solid state physics; including knowledge necessary to understand the basic physical phenomena occurring in hydrogen devices, systems and installations as well as automation and robotics systems	- defines the conditions under which an electric discharge may occur in gas, solid and liquid insulation, - defines the basic lightning and surge protection systems			[SW1] Assessment of factual knowledge		
	[K6_U06] has the preparation necessary to work in an industrial environment, applies the principles of occupational health and safety	- performs basic measurements confirming the electrical strength of the insulating system - calculates safe insulation distances			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject		
	[K6_K01] is aware of the need for continuous education and self-improvement in the field of the profession of an electrician and knows the possibilities of further education	- independently expands knowledge in the field of high-voltage technology towards the classification of high-voltage systems			[SK2] Assessment of progress of work [SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	LECTURE Dielectrics, ionisation processes in gases, forms of discharges, corona, impulse air strength, effect of field distribution, polarity, symmetry, dimensions, time and frequency on electric strength of gases. Compressed gases. Liquid dielectrics, effect of pressure, temperature, humidity, time and frequency, field distribution and electrode dimension on electric strength, applications. Solid dielectrics, mechanisms of breakdown, partial discharges, degradation, dielectric strength of composed insulation systems, surface and gliding discharges. Insulators, application, design, effect of field distribution, pollution and humidity, design of HV power cables and terminations. Lightning, basic parameters, overvoltages, propagation of waves in power lines and windings, principles and methods of lightning protection, co-ordination of insulation. Principles of diagnostics of insulation. LABORATORY Measurement of AC, DC and impulse high voltages. Effect of voltage distribution on discharge form in air at AC, DC and impulse voltages. Effect of ambient conditions on electric strength of air. Insulator testing in dry conditions and under rain. Oil evaluation, Model investigations of wave phenomena in long lines.		
Prerequisites and co-requisites	acquaintance with principles of differential ordinary and partial equations, integral calculus, theory of electric fields, kinetic-molecular theory of gases, principles of thermodynamics, and structure of atom		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	writing test	60.0%	60.0%
	Laboratory passing test	60.0%	40.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. Z. Flisowski: "Technika Wysokich Napięć" (HV engineering), PWN Warszawa 2017.</li> <li>2. Z. Gacek: "Wysokonapięciowa technika izolacyjna" (HV insulation technique), Wydawnictwo Politechniki Gliwickiej, Gliwice 2006</li> <li>3. H. Boryń, A. Rynkowski, S. Wojtas: Laboratorium Techniki Wysokich Napięć. Wydawnictwo Politechniki Gdańskiej, 2007.</li> <li>4. B. Florkowska, J. Furgał, "Technika wysokich napięć", Wydawnictwa AGH, 2017</li> <li>5. S. Szpor i inni, "Technika wysokich napięć" ( HV engineering) WNT, Warszawa, 1978,</li> <li>6. Ravindra Arora and Wolfgang Mosch, High Voltage and Electrical Insulation Engineering IEEE Press , 2011</li> </ol>	
	Supplementary literature	<ol style="list-style-type: none"> <li>1. H. Mościcka-Grzesiak: Inżynieria wysokich napięć w elektroenergetyce, tom I, Wydawnictwo Politechniki Poznańskiej, Poznań 1996.</li> <li>2. S. Szpor: Ochrona odgromowa. WNT 1978</li> </ol>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<p>The streamer mechanism of spark</p> <p>Dielectric loss coefficient</p> <p>Breakdown mechanism of solid materials</p> <p>Breakdown mechanism of liquid dielectrics</p> <p>Measurement of DC high voltages</p> <p>Measurement of AC high voltages</p> <p>Measurement of impulse high voltages</p> <p>The lightning protection of buildings</p> <p>Principles of overvoltage protection for power systems and devices</p>		
Work placement	Not applicable		

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