



Subject card

Subject name and code	Fundamentals of electrodynamics, PG_00058340						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2023	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	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Katedra Elektrotechniki i Inżynierii Wysokich Napięć -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Adam Młyński				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	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	Familiarizing students with the phenomena occurring in the electromagnetic field and methods of their description.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_K04] can react in abnormal and emergency situations, threats to health and life when using automation and robotics components and systems in hydrogen devices and installations	The student is able to determine and assess the exposure to the human body and the environment from the electromagnetic field			[SK5] Assessment of ability to solve problems that arise in practice		
	[K6_W03] knows the methods of analysis of DC and AC circuits, the laws of electrical engineering and the properties of elements of electrical circuits	Student knows and understands the concepts of: electric voltage, electric current, resistance, self and mutual inductance, electric capacitance, inducing of voltages			[SW1] Assessment of factual knowledge		
	[K6_W02] has 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	Student knows the ways of describing and analyzing electric and magnetic fields, he can describe the phenomena occurring in the electric and magnetic fields.			[SW1] Assessment of factual knowledge		
[K6_U04] can apply the learned methods to the analysis and design of electrical elements, devices and systems	Student is able to calculate the parameters of electrical systems (resistance, inductance, capacitance), electrodynamic forces, induced voltages.			[SU3] Assessment of ability to use knowledge gained from the subject			

Subject contents	Electrostatics: Coulomb's law, quantities describing the electric field, Gauss's law, Maxwell's laws for electrostatics, electrostatic properties of the environment, electric capacity. Electric field in a conductive environment: quantities describing the electric field, Maxwell's laws in a conductive environment, electrical properties of the environment, resistance of conductors and earthing. Magnetostatics: Ampere's law, quantities describing the magnetic field, Biot's Savarte's law, Maxwell's laws for magnetostatics, self and mutual inductance, magnetic properties of the environment, magnetic circuits, electrodynamic forces. Faraday's law.		
Prerequisites and co-requisites	Knowledge of vector calculus. Ability to calculate derivatives of functions of many variables. Knowledge of the concept of linear, surface and volume integrals.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written exam	55.0%	70.0%
	Tests during the semester	55.0%	30.0%
Recommended reading	Basic literature	1. Zahn M.: Pole elektromagnetyczne. PWN Warszawa 1989  2. Griffiths D.J.: Podstawy elektrodynamiki. PWN Warszawa 2001  3. Krakowski M: Elektrotechnika teoretyczna, tom 2. Pole elektromagnetyczne. PWN, Warszawa 1980  4. Piątek Z., Jabłoński P.: Podstawy teorii pola elektromagnetycznego. WNT, Warszawa 2010  5. Sikora R.: Teoria Pola Elektromagnetycznego. WNT, Warszawa 1997  6. Sikora J., Skoczylas J., Sroka J., Wincenciak S.: Zbiór zadań z teorii pola elektromagnetycznego. Oficyna Wyd. Politechniki Warszawskiej. Warszawa 2004	
	Supplementary literature	1. Feynman R.P., Leighton R.B., Sands M.: Feynmana wykłady z fizyki (tom II). PWN Warszawa 2001  2. Kurdziel R.: Podstawy elektrotechniki. WNT, Warszawa 1965  3. Rawa H.: Podstawy elektromagnetyzmu. Wydawnictwo Politechniki Warszawskiej	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	1. Calculate the distribution of the electric field intensity from the given system of point charges.  2. What condition should the dimensions of the coaxial cable meet so that the maximum electric field intensity in the cable is minimal.  3. Calculate the capacitance of a single-core, coaxial cable of length $l$ , whose core diameter is $d$ , the inner diameter of the shield $D$ , and the relative permittivity of the dielectric is $\epsilon$ ,  4. Calculate the leakage rate of a coaxial cable of length $l$ , whose core diameter is $d$ , the inner diameter of the shield $D$ , and the insulation conductivity is $s$ .  5. Calculate the self-inductance per unit length of a two-wire line with wires of diameter $d$ separated by a distance $h$ .		
Work placement	Not applicable		