University of Gdańsk

Subject card

Subject name and code	Fundamentals of Electrical Engineering - lecture, PG_00201096						
Field of study	Marine Hydrography						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	Bachelor's studies		Subject group	Obligatory subject group in the field of study			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	1.0			
Learning profile	practical		Assessment form	credit			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Piotr Bekier				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	12.0	0.0	0.0	0.0	0.0	12
	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	12		1.0		12.0	25
Subject objectives	ransfer of knowledge in the field of basic electrical engineering. Mastering the fundamental principles of operating electrical devices.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[HML3-U01] is able to plan and conduct experiments, including computer simulations, interpret the results obtained and draw conclusions	is able to: - analyze a simple electrical circuit	[SU4] test/exam - oral or written
[HML3-W12] knows and understands, at an advanced level, the key processes occurring in the life cycle of devices, facilities, and technical systems	knows and understands at an advanced level: - phenomena related to electrical devices - methodology for measuring electrical quantities in direct current (DC) and alternating current (AC) systems - similarities and differences between various types of electrical devices	[SW4] test/exam - oral or written
[HML3-W03] knows and understands, at an advanced level, directions of development and the latest discoveries in the field of scientific disciplines forming the theoretical basis appropriate to the field of study	knows and understands at an advanced level: - basic laws and relationships in electrical engineering - methodology for measuring electrical quantities in direct current (DC) and alternating current (AC) systems - similarities and differences between various types of electrical devices	[SW4] test/exam - oral or written
[HML3-W01] knows and understands, at an advanced level, selected facts, phenomena and processes, as well as methods and theories concerning them, explaining the complex relationships between them, constituting basic general knowledge in the field of scientific disciplines forming the theoretical foundations specific to the field of study	knows and understands at an advanced level: - fundamental laws and relationships in electrical engineering - phenomena related to electrical devices	[SW4] test/exam - oral or written
[HML3-U11] is able to use navigation devices, means of technical observation and communication as well as measuring instruments, as well as apply in practice various techniques of measurement and observation in the field of professional activity related to the field of study	is able to: - work with electrical devices	[SU4] test/exam - oral or written

Subject contents	Key Concepts in Electric, Magnetic, and Electromagnetic Field Theory**Electric Field Theory**
	
	• **Electric Field and Charge:**
	  • Electric field as a region of space influenced by electric charges.
	  • Definition of **electric charge** and its role in creating an electric field.
	• **Field Intensity and Lines of Force:**
	  • Field intensity as a measure of the force experienced by a charge in an electric field.
	  • **Lines of force** representing the direction and strength of the field.
	  • **Electric flux** as the measure of the total electric field passing through a surface.
	• **Fundamental Laws:**
	  • **Coulombs Law:** Describes the force between two point charges.
	  • **Gausss Law:** Relates the electric flux through a closed surface to the enclosed charge.
	
	Magnetic Field Theory
	
	• **Potential and Electric Voltage:**
	  • Concept of electric potential as work needed to move a charge in an electric field.
	  • Relationship between potential difference (voltage) and the electric field.
	• **Magnetic Field and Forces:**
	  • Definition of **magnetic field** as the space influenced by moving charges or magnets.
	  • **Magnetic force** acting on charged particles in motion or on a current-carrying conductor.
	• **Lines of Magnetic Force:**
	  • Magnetic field lines representing the direction and intensity of the field.
	  • Determination of field direction using the right-hand rule.
	• **Motion of Charged Particles in Magnetic Fields:**
	  • Interaction of charged particles with the magnetic field, resulting in circular or spiral trajectories.
	
	Magnetic Field Interaction with Current:
	
	• **Amperes Law:**
	  • Describes the relationship between current flow and the magnetic field generated around a conductor.
	• **Parallel Current-Carrying Conductors:**
	  • Magnetic interaction between parallel wires carrying currents.
	
	Electromagnetic Induction
	
	• **Faradays Law of Induction:**
	  • Induced electromotive force (EMF) in a loop due to changes in magnetic flux.
	• **Self-Inductance:**
	  • Concept of a circuit generating EMF in response to changes in its own current.
	• **Gausss Law for Magnetism:**
	  • No magnetic monopoles exist; magnetic field lines are continuous.
	
	Induced Fields
	
	• **Electric Field Induction:**
	  • Creation of an electric field from a time-varying magnetic field.
	• **Magnetic Field Induction:**
	  • Creation of a magnetic field from a time-varying electric field.
	
	Fundamental Electrical Engineering PrinciplesElectric Current and Its Properties
	
	• **Electric Current:**
	  • Flow of electric charge, measured as current intensity (III).
	  • **Current density** and the conventional direction of current flow.
	• **Sources of Electrical Energy:**
	  • Ideal vs. real energy sources and their characteristics.
	
	Key Laws in Electrical Circuits
	
	• **Ohms Law:**
	  • Relationship between voltage, current, and resistance: U=IRU = I \cdot RU=IR.
	• **Kirchhoffs Laws:**
	  • Current Law (KCL): Sum of currents entering a junction equals the sum exiting.
	  • Voltage Law (KVL): Sum of voltage drops around a closed loop equals zero.
	
	DC Circuit Analysis
	
	• **Branching Circuits:**
	  • Understanding and solving complex, branched direct current (DC) circuits.
	• **Circuit Analysis Methods:**
	  • **Kirchhoffs Laws Equations:** Deriving systems of equations based on KCL and KVL.
	  • **Circuit Transformation:** Simplifying circuits using series-parallel combinations.
	  • **Mesh Analysis:** Solving circuits by focusing on loop currents.
	  • **Node Analysis:** Focusing on voltages at circuit nodes.
	  • **Superposition Theorem:** Analyzing circuits with multiple sources by superimposing effects.
	  • **Thevenins and Nortons Theorems:** Simplifying networks to equivalent single-source models.

Prerequisites and co-requisites	Knowledge in the fields of algebra, trigonometry of complex numbers, and the fundamentals of electromagnetism.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td></td><td>61.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">KURDZIEL R.: Podstawy elektrotechniki. WNT, Warszawa 1973.
WYSZKOWSKI S.: Elektrotechnika okrętowa. Wydawnictwo morskie, Gdańsk 1972.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">KOSTYSZYN R.: Elektroenergetyka okrętowa. Akademia Morska, Gdynia 2016</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Pytania oraz zadania są powiązane bezpośrednio z treścią przedmiotu.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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