COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S1-ME-109**
	part-time programme:	
Course title in Polish	**Podstawy elektrotechniki**	
Course title in English	**Fundamentals of Electrical Engineering**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**all**
Department responsible	**Department of Automation and Robotics**
Course leader	**Prof. dr hab. inż. Dariusz Janecki**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**programme-specific**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester I**
	part-time programme	
Pre-requisites		
Examination required (YES/NO)		**NO**
ECTS value		**3**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**30**	**15**			
	part-time programme					

LEARNING OUTCOMES

Category of outcome	**Outcome code**	**Course learning outcomes**	**Corresponding programme outcome code**
Knowledge	W01	The student knows and understands the basic laws of physics related to electric and magnetic fields, as well as the properties of electrical circuits.	MiBM1_W01 MiBM1_W02

	W02	The student knows methods for analyzing linear DC and AC circuits, understands Kirchhoff's laws, Thevenin's and Norton's theorems and the superposition principle.	MiBM1_W04 MiBM1_W06
	W03	The student knows and understands the concepts of average, effective, and instantaneous values of electrical signals.	MiBM1_W04 MiBM1_W06
	W04	The student has basic knowledge of the operation of transformers and of three-phase circuits, understands the principles of the creation of a rotating magnetic field.	MiBM1_W04 MiBM1_W06
	W05	The student has basic knowledge basic knowledge of the construction and operating principles of induction motors, direct current (DC) motors, and electronically commutated motors.	MiBM1_W04 MiBM1_W06
	W06	The student has elementary knowledge of the methods of generating, processing, and storing electrical energy.	MiBM1_W04 MiBM1_W06
Skills	U01	The student can calculate the forces acting between electric charges and the parameters of the electric field produced by a system of electric charges.	MiBM1_U01
	U02	The student can calculate the resistance and conductance of a electric cables with defined dimensions and determine changes in resistance and conductance as a function of temperature.	MiBM1_U01
	U03	The student can calculate the values of currents and voltages in DC and AC circuits.	MiBM1_U01
	U04	The student can calculate power and energy in DC circuits.	MiBM1_U01
	U05	The student can calculate active, reactive, and apparent power in AC circuits and select capacitors for reactive power compensation.	MiBM1_U01
Competence	K01	Is aware of the impact of the way electricity is produced and used on the natural environment.	MiBM1_K01 MiBM1_K02
	K02	The student understands the necessity of conducting rational electrical energy management for economic reasons.	MiBM1_K01 MiBM1_K02

COURSE CONTENT

Type of instruction lecture	Topics covered

lecture	- Basic electrical quantities: electric charge, electric current, Coulomb's law, electric field, electric potential and voltage, Ohm's law, resistance and conductance of conductors, dependence of resistance on temperature, work and power of electric current, sources of electrical energy. - DC circuits: graphical symbols of circuit elements, Kirchhoff's laws, voltage and current sources, series and parallel circuits, superposition principle, Wheatstone bridge, Thevenin and Norton theorems, mesh and nodal methods for solving electrical circuits. - Electric field: electrostatic induction, Gauss's theorem, electric field in conductors, electric field in dielectrics, construction of a capacitor, capacitance of a capacitor, connections of capacitors, energy of the electric field in a capacitor. - Magnetic field: magnetic induction, magnetic flux, magnetic field strength, flow law, Biot-Savart law, magnetic properties of materials, magnetization curve, inductance of a coil, mutual inductance, electromagnetic induction phenomenon, eddy currents. - Single-phase AC circuits: AC voltage sources, average value, effective value of currents and voltages, analysis of circuits containing RLC elements, phasor diagrams, instantaneous power, active, reactive and apparent power. - Symbolic method for solving electrical circuits: symbolic form of voltage and current signals, complex reactance and impedance, active, reactive and apparent power. Resonant circuits: series and parallel resonance. - Magnetically coupled circuits: transformers, ideal and non-ideal transformer. - Three-phase currents: asymmetric loads, power of three-phase current. Rotating magnetic field, construction, and operation of induction motors. asynchronous and synchronous. - Direct current (DC) motors (separately excited, shunt, series, and permanent magnet): construction and operating principles, basic relationships, starting and braking of DC motors. - Electronically commutated motors: stepper, brushless permanent magnet motors. - Production, processing and storage of electrical energy.
class	- Basic electrical quantities: electric charge, electric current, Coulomb's law, electric field, electric potential and voltage. - Ohm's law, resistance and conductance, resistivity and conductivity of conductors, dependence of resistance on the geometric dimensions of the conductor, dependence of resistance on temperature, work and power of electric current. Calculating equivalent resistance. - Calculating voltages, currents, potentials, power in branched circuits with one active element. - Real voltage and current sources, resistive voltage divider, Wheatstone bridge, star and delta connections, application of Kirchhoff's laws to calculate currents and voltages in circuits with multiple sources. - Application of the symbolic method to calculate currents and voltages in sinusoidal AC circuits, series and parallel connections of inductance and capacitance, calculating equivalent impedance for a circuit composed of R, L, and C elements. - Power in AC circuits, current and voltage resonance, power factor improvement using compensating capacitors.

ASSESSMENT METHODS

Outcome code	Methods of assessment *(Mark with an X where applicable)*					
	Oral examination	Written examination	Test	Project	Report	Other
W01			X			
W02			X			
W03			X			
W04			X			
W05			X			

W06			X			
U01			X			
U02			X			
U03			X			
U04			X			
U05			X			
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	The pass mark is a minimum of 50% for all the in-class tests.
class	non-examination assessment	The pass mark is a minimum of 50% for all the in-class tests.

OVERALL STUDENT WORKLOAD

ECTS weighting												
No.	Activity type	Student workload										Unit
		full-time programme					part-time programme					
1.	Scheduled contact hours	L	C	Lb	P	S	L	C	Lb	P	S	h
		30	15									
2.	Other contact hours (office hours, examination)	2	2									h
3.	**Total number of contact hours**	**49**										h
4.	**Number of ECTS credits for contact hours**	**2,0**										ECTS
5.	**Number of independent study hours**	**26**										h
6.	**Number of ECTS credits for independent study hours**	**1,0**										ECTS
7.	**Number of practical hours**	**25**										h
8.	**Number of ECTS credits for practical hours**	**1,0**										ECTS
9.	**Total study time**	**75**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**3**										ECTS

READING LIST

1. S. Bolkowski: Elektrotechnika teoretyczna. Teoria obwodów elektrycznych, WNT 1986.
2. R. Kurdziel: Podstawy elektrotechniki. WNT 1973.
3. S. Bolkowski, W. Brociek, H. Rawa, Teoria obwodów elektrycznych – zadania, WNT, 2003.
4. P. Hempowicz i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004.

5. W. Żakowski: Podręczniki akademickie – elektronika. Matematyka. cz.II i cz.IV WNT 1972.
6. T. R. Kuphaldt, Lessons In Electric Circuits, http://www.ibiblio.org/kuphaldt/electricCircuits/
7. A. Cichocki, K. Mikołajuk, S. Osowski: Zbiór zadań z teorii obwodów, WNT 1978.
8. K. Mikołajuk, Trzaska Z.: Zbiór zadań z Elektrotechniki teoretycznej, WNT 1973.
9. E. Gierczak, J. Suchański: Zbiór zadań z elektrotechniki teoretycznej, cz. 1, Wyd. Politechniki Świętokrzyskiej, Kielce 1996.
10. Don Johnson, Fundamentals of Electrical Engineering, Open Textbook Library, https://open.umn.edu/opentextbooks/textbooks/337
11. James M. Fiore, DC Electrical Circuit Analysis, Open Textbook Library, https://open.umn.edu/opentextbooks/textbooks/dc-electrical-circuit-analysis-a-practical-approach-fiore
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13. Chad Davis, DC Circuits, Open Textbook Library, https://open.umn.edu/opentextbooks/textbooks/dc-circuits
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15. Louis Scharf, Richard Behrens, A First Course in Electrical and Computer Engineering, https://open.umn.edu/opentextbooks/textbooks/a-first-course-in-electrical-and-computer-engineering