FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Teoria obwodów 1A**
Name in English:	**Circuits theory 1A**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, part-time**
Kind of subject:	**obligatory**
Subject code:	**ELR051361**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	20	10			
Number of hours of total student workload (CNPS):	30	30			
Form of crediting:	crediting with grade	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	1	1			
including number of ECTS points for practical (P) classes :		1			
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70	0.70			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of complex numbers, matrix algebra using to solve linear equations and analytic geometry in the plane.
2. Has a basic knowledge of the properties of functions (trigonometric, exponential, exponential, logarithmic), calculus and indefinite integrals of functions of one variable, which is necessary for the understanding of mathematical sciences as engineering.
3. Can correctly and effectively apply the knowledge in the field of complex numbers, matrix algebra and differential and indefinite integral functions of one variable, the qualitative and quantitative analysis of the issues related to the engineering discipline of study.
4. Understands the need to know the capabilities and continuous training, raising the professional skills, personal and social.

SUBJECT OBJECTIVES

C1. Ability to analyze linear-phase electrical circuits, also with magnetic couplings.
C2. Student awareness of the applicability of methods, techniques and tools used in electrical engineering to their use in engineering practice.
C3. The sophistication of the ability to apply computational techniques and measuring the steady-state phase in electric circuits.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 He knows the basic laws and theoretical foundations of the theory of electrical circuits.
PEU_W02 He has a basic knowledge in of scope of analysis of linear circuits with sinusoidal excitation, in the steady state.

relating to skills:

PEU_U01 Is able to apply the theoretical basis for the analysis of linear circuits in steady state with sinusoidal AC.
PEU_U02 Is able to apply the theory to have met the qualitative and quantitative evaluation of the physical size of an engineering.

relating to social competences:

PEU_K01 Can think and act in a creative and enterprising.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Familiar with the subject, requirements and method of assessment.	1
Lec 2	Basic notions. Kinds of electric charges. Charge interaction. The law of charge conservation. The notion of the electric field. Work of the displacement of the charge in the electric field. Voltage, potential, electric current. Ohm's Law. Work and power. Dissipation of energy. Capacitor, capacity. The relationship between current and voltage. Energy, the accumulation of energy. Coil. The relationship between current and magnetic flux. The inductance. Faraday's Law. Electromotive force. Active and passive elements. The source of voltage and current. Graphic symbols. Connections of the elements of electric circuits. Linearity, stationarity and causality. Signals. Aperiodic (step signal, impulse signal, exponential signal). Periodical (non-sinusoidal, sinusoidal signal). Average value, effective value. Coefficients of shape and peak. Measurement of the parameters of signals using measuring instruments.	3
Lec 3	Waveforms of voltages and currents on LCR elements. The response of elements LCR to typical signals (step signal, exponential signal, sinusoidal signal). Solving equations describing simple circuits with elements LR and CR. The transitory state. The steady state.	2
Lec 4	The general equation of the branch. Branch equations. The matrix of branch impedances. Ohm's Law and Kirchhoff's Law in the matrix form.	2
Lec 5	The symbolic method. The exponential signal. The complex function of the sinusoidal signal. The complex value. The algebraical and exponential form. The calculations with complex numbers. The geometrical interpretation of complex numbers. Ohm's Law and Kirchhoff statement in the complex form. Vector graphs. Phase shift and temporal delay. Impedance and admittance on the complex plane. Reactance and susceptance.	2
Lec 6	The power in circuits with the sinusoidal current. Instantaneous and apparent power. The triangle of the power. The balance of the power. The coefficient of the power. The notion of active and passive component of voltage and current. The measurement of the power. Calculation of the passive and apparent power on the basis of the indications of instruments. The adjustment of receiver to the source. Efficiency of the source. The drop of the voltage and the loss of the power in the transmission line.	2
Lec 7	The method of loop currents and the node potentials. The notion of the loop current. Branch currents and loop currents (matrix form). The matrix of loop currents. The matrix of loop impedances. The generalized matrix of source voltages. Use of the method of loop currents. Branch voltages and node potentials (matrix form). The matrix node admittances. The generalized matrix of source currents. Use of the method of node potentials.	2
Lec 8	The method of superposition. Equivalent systems. Conditions of application. Examples of the use of the method (bilateral power supply, sources with different pulsations). Notion of the equivalence of multi-terminal systems. The triangle-star transformation. Turning on additional sources. Moving the ideal sources of the voltage through the node. Moving ideal sources in the loop. Use of sources' moving to the exchange of equivalent active triangle-star connections. Statements of Thevenin and Norton. Passive and active two-terminal networks. The voltage of the idle state. Impedance of substitute two-terminal network. Statement of Thevenin about the supplementary source of the voltage. The measurement of parameters of two-terminal network. Idle state and the condition of the short-circuit. The statement of Norton about the substitute current source. The exchange of sources.	4
Lec 9	Circuits with magnetic couplings. The mutual inductance. The positive and negative coupling. De-coupling of the branch about the common node. Form of the matrix of loop impedances and matrix node admittances in circuits with couplings. Transfer of energy by the coupling. The transformer. The transmission.	2
	Total hours:	**20**

Form of classes - class		**Number of hours:**
Cl 1	Familiar with the subject, requirements and method of assessment.	1
Cl 2	Calculation of the average, effective value of simple non -sinusoidal signals. The passage from the temporal waveform to the complex function and inversely.	2
Cl 3	The construction of vector graphs for LCR elements connected in series and parallel. Creating of the matrix of loop impedances.	2
Cl 4	Calculation of currents using the method of loop currents. Creating the matrix node admittance. Calculation the node potentials of electric circuits.	2
Cl 5	Utilization of the method of superposition for solving circuits. Utilization of the statements: Thevenin and Norton to the analysis of current flow.	2
Cl 6	Colloquium	1
	Total hours:	**10**

TEACHING TOOLS USED

N1. Lecture using traditional techniques, audiovisual, multimedia presentations, transparencies.
N2. Exercises conducted in the traditional manner of exercises student groups.
N3. Student's own work.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02	colloquium
P(W)	P=F1	
F1(C)	PEU_U01 PEU_U02 PEU_K01	colloquium
P(C)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Osowski S., Siwek K., Śmiałek M., Teoria Obwodów, Oficyna Wydawnicza Politechniki Warszawskiej, 2006,
[2] Bolkowski S., Teoria Obwodów Elektrycznych, WNT 1995,
[3] R. Kurdziel – Podstawy Elektrotechniki – WNT 1972.
[4] E. Tarnawski, Matetmatyka dla elektryków, PWT – wydanie dowolne
[5] J. Osiowski, Zarys rachunku operatorowego. Teoria i zastosowania w Elektrotechnice, WNT wydanie dowolne
[6] W.Żakowski, W.Leksiński, Matematyka- cz. IV, Seria: Podręczniki Akademickie, WNT Warszawa.
[7] J. Długosz – Funkcje zespolone - teoria , przykłady, zadania – GiS, Wrocław 2001.S. Osowski,
[8] M. Uruski, W. Wolski – Teoria Obwodów t. I, II – skrypt PWr.

SECONDARY LITERATURE:

[1] Mikołajuk K., Trzaska Z., Elektrotechnika Teoretyczna, PWN, 1984,
[2] Osiowski J., Szabatin J., Podstawy Teorii Obwodów, t. I, II, III, WNT 1992-1998
[3] A.Papoulis – Obwody i Układy - WKŁ 1988.
[4] Jackson J. D., Classical Electrodynamics – third edition, John Wiley & Sons, INC, 2001,
[5] Michalski W. Elektryczność i magnetyzm, Zbiór zagadnień i zadań, Oficyna Wydawnicza PWr, 2004.

SUBJECT SUPERVISOR

Paweł Kostyła, pawel.kostyla@pwr.edu.pl