FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Teoria obwodów 1**
Name in English:	**Circuits Theory 1**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR051301**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30	30			
Number of hours of total student workload (CNPS):	90	60			
Form of crediting:	examination	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	3	2			
including number of ECTS points for practical (P) classes :		2			
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10	1.40			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge in of scope of complex numbers and matrix analysis account using to solve systems of linear equations and analytic geometry in the plane,
2. Has a basic knowledge in of scope of the properties of functions (trigonometric, exponential, logarithmic), derivative calculus and unmarked integral of functions of one variable needed to understand mathematic problems in engineering sciences.
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.

SUBJECT OBJECTIVES

C1. Acquaint of students with the basic knowledge necessary to understand the theoretical basis of the analysis of linear circuits in steady state.

C2. Acquisition of the ability to analyze single-phase and three-phase electrical circuits.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

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

PEU_W02 He has knowledge in the field the analysis and interpretation of the phenomenon of resonance of voltages and currents and the magnetic coupling. He has the knowledge concerning of the power and energy absorbed in the single and three-phase circuits and their methods of calculation.

relating to skills:

PEU_U01 He knows how to properly use different methods for solving electrical circuits with sinusoidal excitation.

PEU_U02 Is able to apply the theory to have met the qualitative and quantitative evaluation of the physical size of an engineering. Is able to measure currents and voltage drops and power in series and parallel RLC AC circuits.

relating to social competences:

PEU_K01 He knows how to think in a creative way.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Acquainted with the subject, the requirements and way to complete the course. Electrical circuit. The concept of the signal. The structure of the circuit. Branches, nodes and meshes. Active and passive components. Controlled and uncontrolled sources. Accumulation and dissipation of energy on passive components. Assignment of direction for currents and voltages in the circuit.	2
Lec 2	Passive components: resistor, coil and capacitor. The relationship between voltage and current for passive components.	2
Lec 3	Electrical and structural diagrams of the circuit. Graphs. Tree of graph. Graph-oriented. The matrix structure of the recording circuit. Incidence matrix (the hub and ring). Number of nodes and mesh independent. Relationships between the incidence matrices, Association of voltage potentials.	2
Lec 4	Classification of signals: aperiodic (stroke unit, Dirac pulse, exponential signal) and periodic (non-sinusoidal, sinusoidal signal). Rms value and average of a periodic quantity. Crest factor and shape factor. The electrical properties: linearity, stationarity and causality.The general form of the branches in a circuit. Voltage equation - current. Impedance matrix of branch. Ohm's Law and Kirchhoff's law in the form of a matrix. The balance of instantaneous power consumed by all branches of the circuit.	2
Lec 5	Answer the RLC elements of the typical signals (stroke unit, a signal exponential, sinusoidal signal). Solving equations describing a simple circuit with elements of RL and RC. Transition state. Steady state.The complex function of sinusoidal signal. Complex value, algebraic and exponential form. Action on complex numbers. Geometric interpretation of numbers and operations with complex numbers. application.	2
Lec 6	Ohm's and Kirchhoff's laws in the record of the complex form. Phasor diagrams. Phase shift. The triangle of the voltage, impedance and admittance. The concept of active, reactive and apparent power. Power triangle. Power measurement of dwójnik. Balance of active, reactive and apparent power complex. Active and passive components of the voltage and current. Adjusting the receiver to the source. Voltage drop and power loss in the line. Replacement current source.	2
Lec 7	Systems equivalent to two-and wielozaciskowe. Transforming a triangle - star. The claim of the moving source voltage at the node transfer theorem current sources in the pond. The method of superposition.	2
Lec 8	The method of loop currents: the branch currents and the currents drawn (matrix notation). The matrix of loop currents. Loop impedance matrix. Electromotive force loop matrix. Application of the method of loop currents.	2
Lec 9	Nodal method: the branch voltage and nodal potentials (matrix notation). Nodal admittance matrix. Current source matrix junctions. The use of nodal methods.	2
Lec 10	Thevenin and Norton's theorem: the no-load voltage and impedance substitute of two-terminal network. Theorem Thevenin voltage source for replacement. Short-circuit condition. Norton's Theorem for substitute power source. Swapping sources.	2
Lec 11	Resonance voltages and currents: The resonance conditions. The frequency characteristics of resonant circuits. The importance of resonance in electrical engineering. Reactive power compensation. RLC filters	2
Lec 12	Magnetically coupled circuits: mutual inductance. Jednakoimienne terminals. Positive and negative feedback. Uncoupling gałęzi a common node. Form loop impedance matrix and admittance matrix junctions in circuits with feedback. Transfer of energy through magnetic coupling. Air-core transformer.	2
Lec 13	Three-phase circuits : Multi-phase voltage source. Three-phase circuits in a star and delta connection. Three-and four-wire circuits. Size and interfacial phase. Operator turnover. Phasor diagrams. Distribution of currents in the symmetrical and asymmetrical circuits. The instantaneous power in three-phase circuits. Three-phase power circuits connected in delta and star. Measurement of active and reactive power of the balanced and unbalanced ciccuit in three- and four-wire circuit.	2
Lec 14	The method of symmetrical components: Basic method. Matrix transformations. Circuits of symmetrical components. Impedance of symmetrical components. Longitudinal and transverse disturbances.	2
Lec 15	Four-terminal networks : the definition of terminal network. Classification of four-terminal networks. Terms of reversibility and symmetry. Four-terminal networks equations (caternary, admittance, impedance). Terminal network impedance balanced. Transfer coefficient. Determination of fixed terminal network with alternative schemes, Determination of fixed terminal network measurement. Combining four-terminal networks. The chain of identical symmetric four-terminal networks	2
	Total hours:	**30**

Form of classes - class		Number of hours:
Cl 1	Calculate the mean and effective value of simple non-sinusoidal periodic signals. Determination of circuit parameters sinusoidal alternating voltage supplied on the basis of the measured data.	2
Cl 2	Determination of the complex value for instantaeous process date. Inverse transformation.	2
Cl 3	Construction of vector diagrams for of RLC elements connected in series and in parallel.	2
Cl 4	Creating a loop impedance matrix. Determining the propagation of currents using the method of loop currents.	2
Cl 5	Creating a nodal admittance matrix. Determining the of node potentials of complex circuits.	2
Cl 6	Determining the propagation of currents in the circuit by superposition method.	2
Cl 7	Use Thevenin and Norton methods in the analysis of electrical circuits.	2
Cl 8	Colloquium 1. Solutions and discussion of particular tasks.	2
Cl 9	Determining the resonance conditions.	2
Cl 10	Analysis of resonance overvoltages and overcurrents.	2
Cl 11	Calculation of propagation of currents and voltages in the three-phase symmetrical.	2
Cl 12	Calculation of propagation of currents and voltages in the three-phase asymmetrical circuits. Indication wattmeters.	2
Cl 13	Calculation of single-and multi-phase short-circuits in electric power lines.	2
Cl 14	Calculation of the parameters of four-terminal networks on the basis of alternative schemes and measurements.	2
Cl 15	Colloquium 2. Solutions and discussion of particular tasks.	2
	Total hours:	**30**

TEACHING TOOLS USED

N1. Lecture using traditional techniques, audiovisual, multimedia presentations, transparencies.
N2. Student's own work.
N3. Solving classes.

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	written exam
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

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