Subject (course) name: **Circuit and Signals**		
Programme: **Electronics and Telecommunication** Specialty:		Subject code: **5P**
		Title graduate: **Engineer**
Type of course: **obligatory**	Course level: **First-cycle studies**	Year: **II** Semester: **III** Semester: **winter**
Form of classes: **Lectures, Classes, Labs, Seminar, Project**	Number of hours per week: **1L, 1C, 2Lab, 0, 0**	Credit points: **4 ECTS**

GUIDE TO SUBJECT

SUBJECT OBJECTIVES

C1. General knowledge in circuit description of electrical phenomena by means of voltage and current waveforms of branch treated as electrical analogue signals.

C2. Particular knowledge in calculation and analysis of voltage and current waveforms in the circuit branches subjected to various sources.

C3. General skill description of electrical phenomena occurring in electrical circuits

C4. General ability to combine simple electrical circuits, making the electrical measurements in them and interpretation of the results of measurements and calculations.

C5. Practical knowledge in computer analysis of electric circuits.

SUBJECT REQUIREMENTS

1. Knowledge and skills in mathematics of linear algebra, algebraic operations on complex numbers and the elements of differential and integral calculus.
2. Knowledge of physics in the field of circuit descriptions of electrical phenomena.
3. Knowledge of Electrical Engineering Course
4. Ability to prepare a report of the measurements.
5. Ability to use literature and online resources.

LERNING OUTCOMES

EK 1 - The student has knowledge of the basic concepts and laws in force in the theory of electrical circuits.
EK 2 - The student is able to perform the calculation and analysis of voltage and current waveforms in the branches of an electrical circuit.
EK 3 - The student is able to describe electrical phenomena occurring in electric circuits at different sources.
EK 4 - Student is able to carry out measurements of electrical quantities in the joint by the electrical circuit and interpret the results of measurements and calculations.
EK 5 - The student can perform a computer analysis of the electrical circuit.

SUBJECT CONTENT

Form of classes - lectures

Topic	Hours
W 1 – Resonance voltages in RLC series branch.	**1**
W 2 – Frequency characteristics of current and voltage on the elements of the resonant circuit.	**1**

W 3 – Magnetically coupled coils. Air transformer.	**1**
W 4 – Ideal transformer. Impedance of magnetically coupled coils.	**1**
W 5 – Periodic current circuits.	**1**
W 6 – Fourier series. Amplitude and phase spectra of a periodic signal.	**1**
W 7 – Examples of transients in electrical circuits RL and RC.	**1**
W 8 – Transients in RLC series branch.	**1**
W 9, 10 – Laplace Transform. Properties of the Laplace transform.	**1**
W 11, 12 – Operator method of transients analysis.	**1**
W 13, 14 – Operator circuit diagram. Heaviside equation.	**1**
W 15 – Final test.	**1**
Total	**15**

Form of classes – classes

Topic	Hours
C 1 – Resonance voltages in RLC series branch.	**1**
C 2 – Frequency characteristics of current and voltage on the elements of the resonant circuit.	**1**
C 3 – Magnetically coupled coils. Air transformer.	**1**
C 4 – Ideal transformer. Impedance of magnetically coupled coils.	**1**
C 5 – Periodic current circuits.	**1**
C 6 – Fourier series. Amplitude and phase spectra of a periodic signal.	**1**
C 7 – Examples of transients in electrical circuits RL and RC.	**1**
C 8 – Transients in RLC series branch.	**1**
C 9, 10 – Laplace Transform. Properties of the Laplace transform.	**1**
C 11, 12 – Operator method of transients analysis.	**1**
C 13, 14 – Operator circuit diagram. Heaviside equation.	**1**
C 30 – Final test.	**1**
Total	**15**

Form of classes – laboratory

Topic	Hours
L 1 – Introduction to the lab.	**2**
L 2 – The power and efficiency of the DC. Thevenin Theorem.	**2**
L 3 – Nonlinear DC circuits.	**2**
L 4 – The study of RLC circuits with sinusoidal sources.	**2**
L 5 – Resonance in RLC serial branches (voltage resonance).	**2**
L 6 – Magnetically coupled circuits.	**2**
L 7 – Transients in RC circuits.	**2**
L 8 – Test	**2**
L 9 – Network analysis of DC circuits.	**2**
L 10 – Network analysis of sinusoidal alternating current circuits.	**2**
L 11 – The analysis of periodic current circuits.	**2**
L 12 – Transients in the serial RLC branches.	**2**
L 13 – Periodic solutions in nonlinear electrical circuits.	**2**
L 14 – Analysis of circuits containing controlled sources.	**2**
L 15 – Test.	**2**
Suma	**30**

STUDY METHODS

1. Lectures with use of multimedia presentations.
2. Solving problems in classes.
3. Lab – experiments in sections (two or three students). Computer analysis.
4. Discussion during the course and individual consultations.

EDUCATIONAL TOOLS

1. Audiovisual equipment
2. Lab instructions
3. Lab equipment.
4. Computer lab
5. Matlab software

METHODS OF ASSESMENT (F – Forming, P – Summary)

F1. Validation of the results of measurements and computer analyses in the laboratory and timely preparation of reports on the subsequent laboratory.
P1. Lecture - written exam.
P2. Classes - final test.
P3. Laboratory classes - the average of the ratings for laboratory exercises 50% and 50% of the final test.

STUDENT WORKLOAD

Form of activity		Averaged workload (hours)		
		[h]	∑ [h]	ECTS
Participation in class activities	lectures classes labs	15 15 30	60	2
Preparation for tutorials (reading literature)		10	60	2
Preparation for classes		10		
Preparation for labs		10		
Preparation of lab reports		10		
Preparation for tests		10		
Preparation for exam		10		
Total			**120**	**4**

A. BASIC READING

1. Nahvi M., Edminister J.A., Schaum's Outline of Electric Circuts, McGraw-Hill.
2. Syed A. Nasar, 3000 solved problems in electrical circuits, Schaum's Solved Problems Series, McGraw-Hill, 1988.
3. Piątek Z., Electrical design. Part II – AC analysis, digital version accessible in The Main Library of Częstochowa University of Technology.
4. Piątek Z., Electrical design. Part III – transient analysis, digital version accessible in The Main Library of Częstochowa University of Technology.
5. Kuphaldt T., Lessons in electric circuits, volume 2 – AC, digital version freely accessible at http://www.ibiblio.org/kuphaldt/electricCircuits/
6. Cichowska Z., Pasko M., Przykłady zadań z elektrotechniki cz.II., t. 1,2. Wyd. Pol. Ślas., Gliwice 2000.
7. Lubelski K., Elektrotechnika teoretyczna. Część 1-4. Wyd. Pol. Czest., Częstochowa 1994.

B. FURTHER READING

1. Charles Alexander, Matthew Sadiku, Fundamentals of electric circuits, McGraw-Hill, 2008.
2. William H. Hayt, Jack Kemmerly, Steven M. Durbin, Engineering circuit analysis, McGraw-Hill, 2007.

Learning objectives	**In relation to the learning outcomes specified for the field of study**	**Subject objectives**	**Study methods**	**Methods of assessment**
EK1	K_W02 K_W14	C1	lecture	P1
EK2	K_W14 K_U01	C2	lecture classes laboratory	P1, P2 F1
EK3	K_W14	C2,C3	lecture classes laboratory	P1 P2 F1
EK4	K_W15 K_U02 K_K04	C3,C4	laboratory	F1,P3
EK5	K_W09 K_W14 K_U07	C2,C5	laboratory	F1,P3

II. EVALUATION

Grade	Outcome
EK1	**The student has knowledge of the basic concepts and laws in force in the theory of electrical circuits.**
2 (F)	The student is not able to describe the basic concepts and laws in force in the theory of electrical circuits.
3 (E)	Student is able to describe the basic concepts and laws in force in the theory of electrical circuits.
4 (C)	The student is able to define the basic concepts and formulate the laws in force in the theory of electrical circuits.
5 (A)	The student is able to define the basic concepts and formulate the laws in force in the theory of electrical circuits and to interpret them, and to illustrate examples.
EK2	**The student is able to perform the calculation and analysis of voltage and current waveforms in the branches of an electrical circuit**
2 (F)	The student is unable to perform the calculation and analysis of voltage and current waveforms in simple electric circuits.
3 (E)	The student is able to formulate equations allow to calculate the voltage and current waveforms in simple electric circuits.
4 (C)	The student can calculate the voltage and current waveforms in simple electric circuits.
5 (A)	The student can perform the calculation and analysis of voltage and current waveforms in simple electric circuits.
EK3	**The student is able to describe electrical phenomena occurring in electric circuits at different sources.**
2 (F)	The student is not able to describe the electrical phenomena occurring in electrical circuits at different sources.
3 (E)	The student is able to describe some electrical phenomena occurring in electrical circuits at different sources
4 (C)	The student is able to describe electrical phenomena occurring in electric circuits at different sources discussed in the lectures
5 (A)	The student is able to describe electrical phenomena occurring in electric circuits at different sources discussed in the lectures referring to the definitions of key terms and phrases laws in force in the theory of electrical circuits.
EK4	**Student is able to carry out measurements of electrical quantities in the joint by the electrical circuit and interpret the results of measurements and calculations.**
2 (F)	The student is not able to carry out measurements of electrical connected by the electrical circuit and interpret the results of measurements and calculations.
3 (E)	Student is able to carry out measurements of electrical quantities in the joint by the circuit and get the correct results.
4 (C)	Student is able to carry out measurements of electrical quantities in the joint by the electrical circuit and interpret the results of measurements and calculations.
5 (A)	Student is able to carry out measurements of electrical quantities in the joint by the electrical circuit and interpret the results of measurements and calculations referring to their theoretical justifications.
EK5	**The student can perform a computer analysis of the electrical circuit.**
2 (F)	The student is not able to carry out a computer analysis of the electrical circuit.
3 (E)	Student is able to perform computer analysis of the circuit and get the correct results.
4 (C)	Student is able to perform computer analysis of the electrical circuit and interpret the results.
5 (A)	Student is able to perform computer analysis of the electrical circuit and interpret the results obtained by referring to their theoretical justification or another method of analysis.

III. OTHER USEFUL INFORMATION

1. All information for students on the schedule are available on the notice board and on the website: www.el.pcz.pl
2. Information on the consultation shall be provided to students during the first lecture and will be placed on the website www.el.pcz.pl
3. Terms and conditions of credit courses will be provided to students during the first lecture