

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Obwody i układy**  
 Name in English: **Circuits and Systems**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable): **Renewable Energy Systems**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR031332**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30	15			
Number of hours of total student workload (CNPS):	60	30			
Form of crediting:	examination	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	2	1			
including number of ECTS points for practical (P) classes :		1			
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40	0.70			

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knows basic laws of electrical engineering and recognize electrical quantity.
2. Knows differential and integral calculus of one variable function, linear algebra and mathematic calculation in complex domain.
3. Can implement basic differential calculation, linear algebra and calculation on complex number.
4. Can recognize fundamental electrical problems and tools for its solution.

**SUBJECT OBJECTIVES**

- C1. Getting the knowledge techniques used in synthesis of electrical circuits.  
 C2. Acquire skills of nonlinear circuit analysis.  
 C3. Getting the knowledge about state variable matrix application.  
 C4. Getting the knowledge about application of continuous representation of signals, transfer function in operator and frequency form.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Have knowledge about circuit synthesis  
 PEK\_W02 Knows elements of nonlinear circuits analysis including stability issues  
 PEK\_W03 formulate general theory of system description using state variable matrix. Formulate general theory of system description using transfer function in operator and frequency form

*relating to skills:*

- PEK\_U01 Decide and select method of circuit synthesis on the basis of immittance function  
 PEK\_U02 Is able to analyze fundamental circuits with nonlinear elements  
 PEK\_U03 Is able to use state variable matrix in system description. Is able to use transfer function in operator and frequency form in system description

*relating to social competences:*

- PEK\_K01 Is responsible for entrusted task, exhibits creative attitude in selection of calculation techniques

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Introduction to circuits and electrical systems. Properties of circuits General problems description of the circuits according to the circuit components and operating state. General issues concerning signal transfer through the system.	2
Lec 2	Selected issues of circuits synthesis. positive rational functions, immittance function of driving point impedance.	2
Lec 3	Selected issues of circuits synthesis. Techniques for synthesis of passive RC, RL, LC circuits, Foster and Cauer synthesis. Part 1.	2
Lec 4	Selected issues of circuits synthesis. Techniques for synthesis of passive RC, RL, LC circuits, Foster and Cauer synthesis. Part 2.	2
Lec 5	Selected issues of nonlinear circuits analysis. Characteristics of driving point nonlinear elements.	2
Lec 6	Selected issues of nonlinear circuits analysis. Selected methods of nonlinear circuits analysis.	2
Lec 7	Selected issues of nonlinear circuits analysis. Stability of nonlinear circuits, phase plane.	2
Lec 8	Selected issues of nonlinear circuits analysis. Stability of nonlinear circuits, stability in Lapunov theory.	2
Lec 9	Selected issues of time series and matrix functions. differential and integral operation of matrix functions.	2
Lec 10	Selected issues of time series and matrix functions. State variable, transfer matrix, excitation matrix, output matrix.	2
Lec 11	Selected issues of time series and matrix functions. Application of engine values.	2
Lec 12	Selected issues of continuous representation of deterministic signals. Two-side Laplace transform, convergence area, inverse transformation.	2
Lec 13	Selected issues of continuous representation of deterministic signals. Fourier transform, relation of two-sides Laplace and Fourier transforms, signal parameters in time and frequency domain.	2
Lec 14	Selected issues of continuous representation of deterministic signals. Transfer function of LTI circuits, elements of filter synthesis. Hilbert compound.	2
Lec 15	Selected issues of continuous representation of deterministic signals. Elements of filter synthesis.	2
Total hours:		30

Form of classes - class		Number of hours:
Cl 1	Information about the regulation of time schedule and requirements for passing the course. Application of synthesis of linear circuit - introduction	2
Cl 2	Application of synthesis of linear circuit	2
Cl 3	Application of methods of nonlinear circuits analysis. Part 1	2
Cl 4	Application of methods of nonlinear circuits analysis. Part 2	2
Cl 5	Application of state variable matrix in analysis of the circuits analysis. Part 1	2
Cl 6	Application of state variable matrix in analysis of the circuits analysis. Part 2	2
Cl 7	Application of transfer function of LTI circuits	2
Cl 8	Crediting test	1
Total hours:		15

## TEACHING TOOLS USED

- N1. Lectures with multimedia presentation  
N2. Classes work in subgroup

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEK_W01 PEK_W02 PEK_W03	Examination
P(w)	P=F1	
F1(c)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Crediting test
P(c)	P=F1	

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [1] A. Papoulis – Obwody i układy, WKiŁ, 1998 (PL) / A. Papoulis – Circuits and Systems: A modern approach, The Oxford Series in Electrical and Computer Engineering (EN)
- [2] S. Haykin, B. Van Veen – Signals and systems, John Wiley & Sons, Inc., 1999.
- [3] S T.H. Glisson – Introduction to system analysis, McGraw-Hill, Inc, 1985.
- [4] G. E. Carlson – Signal and linear system analysis, John Wiley & Sons, Inc., 1998.
- [5] Ch.T. Chen – System and signal analysis, Oxford University Press, 1994.

### SECONDARY LITERATURE:

- [1] A. D. Poularikas - The handbook of formulas and tables for signal processing, CRC Press, 2000
- [2] Materiały pomocnicze: <http://eportal.eny.pwr.wroc.pl/>

## SUBJECT SUPERVISOR

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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR031332 - Circuits and Systems** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering** AND SPECIALIZATION **Renewable Energy Systems**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ETK_W01	C.1	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	K2ETK_W01	C.2	Lec5 Lec6 Lec7 Lec8	N.1
PEK_W03	K2ETK_W01	C.3 C.4	Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	K2ETK_U01	C.1	CI1 CI2	N.2
PEK_U02	K2ETK_U01	C.2	CI3 CI4	N.2
PEK_U03	K2ETK_U01	C.3 C.4	CI5 CI6 CI7	N.2
PEK_K01	K2ETK_K01	C.1 C.2 C.3 C.4 C.5	CI1 CI2 CI3 CI4 CI5 CI6 CI7 CI8	N.2