DESCRIPTION OF THE COURSES

- Course code: ***ELR1311***
- Course title: ***Selected problems of circuit theory (E)***
- Language of the lecturer: *English*

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*	*1*			
*Number of hours/semester**	*30*	*15*			
Form of the course completion	*Exam*	*Test*			
ECTS credits	***3***	***2***			
Total Student's Workload	***90***	***60***			

- Level of the course (basic/advanced): ***Advanced***
- Prerequisites: ***Mathematics, Differential Equations, Linear Algebra, Basic Circuit Theory***
- Name, first name and degree of the lecturer/supervisor: ***Łobos Tadeusz, professor***
- Names, first names and degrees of the team's members: ***Leonowicz Zbigniew, dr***

  Sikorski Tomasz, dr

- Year:.....***1***..... Semester:.....***II***.....
- Type of the course (obligatory/optional): ***Obligatory***
- Aims of the course (effects of the course):
  Effect of the course: ability to carry out synthesis of electrical circuits with optimization approach, knowledge about phenomena in nonlinear circuits, selected methods of analysis.
- Form of the teaching (traditional/e-learning): ***Traditional***
- Course description:
  The course contains selected problems of Synthesis of Linear Circuits & Systems, as well as Analysis of Nonlinear Electrical Circuits - theoretical and practical aspects of linear circuits design based on different methods and requirements. Furthermore, the course contains aspects of nonlinear circuits' analysis, structures, with practical examples and exercises.

- Lecture:

Particular lectures contents	*Number of hours*
1. General presentation of the problem of synthesis of electrical circuits. Classical and optimization approaches. System functions (system operators).	2h
2. Synthesis of LLS one-ports: reactance one-ports, canonical structures. Time-domain system functions: differential equations, impulse response	4h

functions. Frequency-domain system functions: spectral, operational transmittances.	
3. Synthesis of time-varying one-ports: description of time-varying systems, linear differential operators, parametric convolution, time-frequency representations. Design of time-varying systems.	3h
4. Synthesis of one-ports: canonical structures, first-order recursive systems, non-recursive systems, system described with convolution operator.	2h
5. Synthesis of multi-poles and multi-ports. Synthesis methods. Transfer function description. Reliability.	2h
6. Optimization approach to synthesis of electrical circuits.	2h
7. Errors and influence of disturbances, sensitivity analysis, elements of calculus of variation. Stability (BIBO-, Lyapunov-stability)	2h
8. Applications of synthesis of electrical circuits to filter design, function converters and to design of matching systems and compensators in power systems.	2h
9. Introduction to nonlinear circuits. Parameters of nonlinear one-ports (static and dynamic), characteristic phenomena in nonlinear circuits.	1h
10. Circuits with resistance inertial elements. Analysis methods. Conditional linearization of characteristics. Examples.	1h
11. Circuits with resistance inertialess elements. Examples.	1h
12. Circuits with electric arc.	1h
13. Magnetic circuits, chokes. Circuits with permanent magnets. Method of analytical approximation, geometric methods of analysis. Transformer – nonlinear phenomena. Analysis based on Bessel functions.	2h
14. Nonlinear reactance circuits. Ferroresonance. Spectral analysis, subharmonic oscillations.	1h
15. Duffing equation, small parameter method, Fourier analysis-based methods, elliptic integrals, state-space representation of nonlinear circuits.	2h
16. Stability of nonlinear circuits. Local stability analysis.	2h

- Classes – the contents:

1. Design of reactance one-ports. Fixed and variable structure, canonical structures, signal space methods.
2. Design of RC one-ports. Design of one-ports with one time-varying parameter.
3. Design of one-ports based on given transmittance.
4. Analysis of nonlinear magnetic circuits, analytical approximation, linearization method, polynomial approximation.
5. Analysis of nonlinear circuits in transient state.
6. Harmonic methods.
7. State-space representation based methods.
8. Stability and sensitivity analysis of linear and nonlinear circuits.

- Basic literature:

[1] L.A. Chua, C.A. Desoer, E.S. Kuh: Linear ad Nonlinear Circuits, New York : McGraw-Hill Book Co., 1987.
[2] H. Baher: Synthesis of Electrical Networks, New York: J. Wiley, 1984.
[3] F. Kouril, K. Vrba.: Non-Linear And Parametric Circuits : Principles, Theory And Applications, Chichester : Ellis Horwood, 1988.

- Additional literature:

[1] Wai-Kai Chen: The Electrical Engineering Handbook, Elsevier, 2005
[2] R.M. Mersereau, J. R, Jackson: Circuit Analysis. A System Approach, Pearson Education Inc., 2006.

- Conditions of the course acceptance/credition: ***Passed test in classes***

Passed exam in lectures

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