RTU Course "Circuit Theory"

13223 Elektronikas pamatu katedra

General data

Code	RTR215
Course title	Circuit Theory
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Electronics and Telecommunications
Responsible instructor	Kārlis Brīvkalns
Academic staff	Jānis Semeņako Andrejs Strauts Juris Grēve Gatis Valters
Volume of the course: parts and credits points	1 part, 5.0 Credit Points, 7.5 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Maximum auditorium capacity	200
Maximum number of students per semester	200
Abstract	Transient analysis of electric circuits. First order circuits. Second order circuits. State variable analysis. Discrete-time convolution. Continuous-time convolution. Convolution algebra. Laplace transforms. Transfer function. Bode plots. Two-port networks. Two-port parameters. Two-port interconnections. Introduction into electric filter analysis.
Goals and objectives of the course in terms of competences and skills	To acquaint students with the basic concepts of electric circuit transient analysis. To teach students how to analyze first order and second order circuits in time domain and in frequency domain. To develop an understanding of graphical and analytic convolution. To teach students principles of drawing Bode plots. To acquaint students with the basic two-port and electric filter analysis. To teach students how to use PSpice and MATLAB computer programs for electric circuit analysis.
Structure and tasks of independent studies	1.Preparation for the laboratory, calculations, submitting lab reports and defending of lab reports. Defence of lab reports is arranged at a set time. Objective: to develop experimental and simulation skills and promote understanding of the theoretical material. 2.Submission of a term paper. Objective: to develop theoretical calculation skills and competence in application of simulation software. 3.Submission of home assignments. Objective: to develop consistently skills in electric circuit calculations, to prepare for examination.
Recommended literature	1.Brīvkalns, K. Ķēžu teorija: vadonis ķēžu teorijas studijām. 6. izd. Rīga, 2008. 2.Brīvkalns, K. Ķēžu teorija: vadonis ķēžu teorijas studijām. 5. izd. Rīga, 2007. 3.Brīvkalns, K. Svārstību kontūri. Rīga: RTU, 1990. 91 lpp. un 1993. 4.Misāns, P. Ievads inženiermatemātikas datorrealizācijā. Rīga: Pimars, 2003. 5.Strauts, A. Elektrotehnikas teorētiskie pamati. Rīga : RTU, 2007. 196 lpp. 6.Brāzma, N. Augstākās matemātikas speckurss. Rīga : Zvaigzne, 1968-1969. 2 sēj. 7.Dorf, Richard C., Svoboda, James A. Introduction To Electric Circuits, 7th ed. Hoboken, N.J. : Wiley, c2006. 854 lpp. 8.Thomas, Roland E., Rosa, Albert J.The Analysis and Design of Linear Circuits, 2006. 9.DeCarlo, Raymond A., Pen - Min Lin. Linear Circuit Analysis. Englewood Cliffs (N.J.) : Prentice Hall, 1995. 801p. 10.Alexander, Charles K., Sadiku, Matthew N.O. Fundamentals of Electric Circuits, 2000.
Course prerequisites	General Physics and Calculus. Differential Equations. Complex Numbers. Complex Variable Analysis. Theoretical Foundations of Electrical Engineering. Basics of MATLAB.

Course outline

Theme	Hours
Introduction into Circuit Theory. Course Overview. State Variable Analysis.	2
First Order Circuits. Zero Input Response of the RC and RL Circuits.	6
Zero State Response of the RC and RL Circuits. Total Response of the First Order Circuits.	6
Unit Step Response and Impulse Response of the First Order Circuits.	4
Second Order Circuits. Solution of the Second Order Differential Equation.	10
Unit Step Response and Impulse Response of the Second Order Circuits.	4
Discrete Time Function Convolution.	2
Continuous Time Function Convolution.	2
Convolution Algebra.	2
Overview of Laplace Transform Analysis.	4
Elementary Properties of Laplace Transform.	2
The Inverse Laplace Transform.	4

Applications of Laplace Transform Analysis.	4
Transfer Function. Poles, Zeros and s-Plane.	4
Bode Plots. First-Order Terms.	4
Bode Plots. Higher-Order Terms.	4
Two-Port Networks. Two-port Parameters.	2
Impedance, Admittance, Hybrid and Transmission Parameters.	2
Interconnections of Two-port Networks.	4
Input and Output Impedances of Two-Port Networks. Image Parameters.	2
Basics of Image Parameter Filters. Introduction to Filter Design.	6
Series and Parallel Resonant Circuits.	16

Learning outcomes and assessment

Learning outcomes	Assessment methods
Ability to analyze first order and second order circuits using differential equations.	Home assignments, Term Paper, Defending of lab work reports, Examination.
Ability to use computer simulation tools for analyzing first and second order circuits.	Home assignments, Term Paper, Defending of lab work reports.
Ability to write state variable equations and solve them with MATLAB.	Term Paper, Examination.
Ability to determine the unit step and impulse response.	Home assignments, Term Paper, Examination
Ability to apply graphical convolution procedure.	Home assignments, Examination.
Ability to perform Laplace transform analysis.	Home assignments, Term Paper, Defending of lab work reports, Examination.
Ability to analyze Transfer Function and ability to draw Bode Plots.	Home assignments, Term Paper, Defending of lab work reports, Examination.
Ability to analyze Two-Port Circuits.	Defending of lab work reports, Examination.
Ability to provide experimental and analytical determination of series and parallel resonant circuit parameters.	Defending of lab work reports.

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	5.0	7.5	3.0	2.0	1.0		*	