RTU Course "Fundamentals of DC Circuits"

13223 Department of Fundamentals of Electronics

General data

Code	RTR805
Course title	Fundamentals of DC Circuits
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Jānis Semeņako
Academic staff	Tatjana Solovjova Romāns Kušņins
Volume of the course: parts and credits points	1 part, 2.0 Credit Points, 3.0 ECTS credits
Language of instruction	LV, EN
Annotation	Within the study course, the student will learn linear electric circuits basic concepts and laws. The main methods of circuit calculation and analysis, various calculation methods, application of theory in circuit calculations are mastered. The study course explains how to analyse circuits that have direct current or voltage sources. The study course provides insight into the application of circuit simulator SPICE software LTSpice and MATLAB in circuit calculations. The acquired knowledge is essential for the acquisition of further study courses.
Goals and objectives of the course in terms of competences and skills	The aim of the study course: 1) to provide knowledge about the basic values of electrical circuits, elements of circuit theory; 2) to create and develop skills and abilities to perform circuit calculations and analysis, calculate currents and voltages in circuits in direct current modes, to use fundamental and modern circuit calculation methods; 3) to develop skills to solve problems independently, think logically, analyse, and explain the results. The tasks of the study course: 1) to present with the principles, theorems, methods used in circuit theory and to teach to apply them in circuit calculations and analysis; 2) to develop skills to perform calculations with modelling software and numerical calculation software MATLAB (or similar software).
Structure and tasks of independent studies	1. Self-study of textbooks. In-depth self-study of topics. 2. As necessarily designed 2 individual complexes homework. 3. While doing homework skills in application of theory are developed, also students get prepared to the tests and examinations. 4. Preparation of the theoretical part of the laboratory work, processing of work results, design of the report..
Recommended literature	Obligātā. / Obligatory: R.E. Thomas, A.E. Rosa and G.J. Toussaint. The analysis and design of linear circuits, 8th ed. USA: Wiley, 2016. C. K. Aleksander and M. N.O. Sadiku. Fundamentals of Electric Circuits, 5th ed. USA: McGraw Hill, 2013. Strauts, A. Elektrotehnikas teorētiskie pamati: Lekciju konspekts. Rīga: RTU, 2007. Brīvkalns K., Strauts A. Elektrotehnikas teorētiskie pamati, laboratorijas darbi, MatLab programmas un PSpice pielietojumi. Rīga: RTU, 2008. Papildu. / Additional: Andrejs Strauts. . Metodiskie norādījumi semināru uzdevumu risināšanas gaitā, vingrinājumu un mājas darbu uzdevumi Rīga,2009 W.H. Hayt, J. E. Kemmerly and S.M. Durbin. Engineering Circuit Analysis 8-th ed. New York: McGraw Hill, 2012. В. И. Вепринцев, Г. К. Былкова, В. В. Тюрнев, А. В. Изотов и др.. Основы теории цепей Конспект лекций Краснярск: Сибирский федеральный университет, 2008
Course prerequisites	Elementary algebra, solutions of systems of linear algebraic equations, matrices, derivation. Mathematics and physics (at high school level).

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Basic concepts of electric circuits theory and related physical quantities. Practical application of theory.	4	2	0	0
Active elements – independent and dependent (controlled) sources. Resistive element. Ohm’s law. Circuit (also network) topology elements. Kirchhoff's voltage law and Kirchhoff's current law.	4	4	0	0
Resistive circuits and their connections. Equivalent transformations of circuits with passive and active elements. Equivalent circuits of complicated connections. Calculations of power.	4	6	0	0
System of equations of circuit. Nodal analysis, reference node, extraordinary node. Mesh analysis. Supermesh. Comparison of nodal analysis and mesh analysis. .	8	8	0	0
Introduction to SPICE based circuit simulation software LTspice and application of MATLAB for numerical calculation techniques and simulations of circuits.	0	4	0	0

Thévenin's theorem and Norton's theorem for circuits with independent and with dependent sources.	4	4	0	0
Circuit analysis principles and theorems. Linearity, proportionality, superposition and reciprocity principle.	4	2	0	0
Operational amplifier. Analysis of resistive circuits with operational amplifier by using laws of Kirchhoff.	4	2	0	0
Consultations, homework analysis, design, defence of works, rewriting of tests, preparation for the exam.	6	8	0	0
Final exam.	2	0	0	0
Total:	40	40	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to make calculations for circuits with resistive elements using Ohm's law and Kirhhoff's laws, voltage and current division. Able to perform equivalent circuits transformation	Test No.1. (Circuit Terms: Node, Path, Loop, and Branch, Kirhhoff's laws), Test No. 2. (equivalent circuits transformation, simple circuits). Final exam. Circuit Terms: Node, Path, Loop, and Branch Seminars. Final exam.
Knows how to use basic nodal analysis and mesh analysis, able to compile and solve equations for circuit calculation and solve it analytically and numerically by MATLAB.	Test No. 3 (nodal and mesh analysis). Homeworks No. 1. (DC circuits with independent sources), No. 2 (DC circuits with independent and dependent sources). Final exam.
Knows how to apply in calculations and analysis the principles of circuit's theory - linearity, proportionality, reciprocity and superposition and Thevenin's and Norton's theorems.	Test No. 4 (principles and theorems). Homeworks No.1 and No. 2. Final exam.
Able to calculate instantaneous power and average power. Able to use and calculate power balance for resistive circuits.	Homeworks No.1 and No. 2. Final exam.
Able to analyse and calculate circuits with operational amplifiers.	Final exam.

Evaluation criteria of study results

Criterion	%
Homeworks	40
Tests (control works)	40
Final exam	20
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	2.0	1.0	1.0	0.0		*	