RTU Course "Fundamentals of AC Circuits"

13223 Department of Fundamentals of Electronics

General data

Code	RTR806
Course title	Fundamentals of AC Circuits
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Jānis Semeņako
Academic staff	Romāns Kušņins Tatjana Solovjova
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN
Annotation	The study course is fundamental to the calculation of stationary sinusoidal processes in circuits with linear elements - resistive, inductive and capacitive elements, ideal transformer. The symbolic method is used for calculating harmonic processes in the frequency domain. The study course looks at how to calculate amplitude and phase characteristics of different circuits, calculate complex power. The study course covers the theory of circuit calculations as well as laboratory measurements and circuit calculation application of SPICE based electronic circuit simulation software LTspice and MATLAB for numerical calculation techniques and simulations of circuits.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is: 1) to provide knowledge about the elements of linear circuit theory and their volt-ampere characteristics (element constraints) in the time domain and frequency domain (harmonic sources operate in a stationary mode in the circuit); 2) to create and develop skills and abilities to perform calculations and analysis of circuits, to apply the methods, principles and theorems of circuit theory in the phasor domain; 3) to acquaint with the frequency characteristics of circuits, their calculation and measuring. The tasks of the study course are: 1) to teach to perform circuit calculations and analysis for sinusoidal stationary mode analytically, numerically and to use modelling software; 2) to teach to perform measurements of electrical circuit sizes in the laboratory 3) to develop skills to compare analytical and numerical calculations with modelling data and measurements in the laboratory.
Structure and tasks of independent studies	1. Preparation for laboratory works, the home calculation (before work) of physical quantities for verification in the laboratory, creation of protocols, submitting and defence of reports. Develop laboratory work practical skills, skills in work with simulation software, skills in data acquisition, visualization, calculation and analysis are developed. 2. Solution of homeworks. Develop skills in the application of theory is developed, also, students get prepared for the tests and examinations. 3. Self-study with textbooks. In-depth self-study of topics.
Recommended literature	Obligātā. / Obligatory: W.H. Hayt, J. E. Kemmerly and S.M. Durbin. Engineering Circuit Analysis, 8th ed. New York: McGraw Hill, 2012. R.E. Thomas, A.E. Rosa and G.J. Toussaint. The analysis and design of linear circuits, 8th ed. USA: Wiley, 2016. Papildu. / Additional: 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. C. K. Aleksander and M. N.O. Sadiku. Fundamentals of Electric Circuits, 5th ed. USA: McGraw Hill, 2013. В.П. Бакалов, В.Ф.Дмитриков, Б.И. Крук. Основы теории цепей. 3-е изд. . Москва: Гоячая линия -Телеком, 2007.
Course prerequisites	Complex numbers, calculus, derivatives, simple integrals, homogeneous linear first order differential equations. Physics (electricity and magnetism 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
L elements and C elements. Energy storage in L and C. Omh's and Kirchhoff's laws in integro-differential form for circuits with R, L, C elements. Signals. sinusoidal and periodical signals characteris	4	2	0	0
Complex numbers and values.	0	4	0	0
Sinusoidal steady state (SSS) reaction. Complex amplitudes (Phasors). Applying a complex forcing function. Impedance and admittance. Phasor diagrams.	4	2	0	0
Equivalent transforms. AC circuit power analysis. Complex power.	6	4	0	0
Forcing and response functions in calculations of SSS circuits. Amplitude and phase characteristics. Frequency response of circuit.	8	8	0	0

Application of circuits' calculation methods for SSS mode in frequency domain and for DC.	10	6	0	0
Application of circuits' analysis methods and theorems for SSS mode in frequency domain and for DC.	8	12	0	0
Mutual inductance (M). Calculations of circuits with mutual inductance. Ideal transformer.	8	12	0	0
Three-phase circuits and calculation of them.	0	4	0	0
Consultations. Design and defence of laboratory works, preparation for the exam.	10	6	0	0
Final exam.	2	0	0	0
Total:	60	60	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to perform circuit calculations with the complex amplitude method. Able to apply the basic laws, theorems and principles of circuits for calculation of harmonic mode, able to calculate and analyse the frequency responses of R, L, C circuits in harmonic processes.	Tests No.1. – No.4. Laboratory works No. 1. – No. 3. Final exam.
Able to perform circuit calculations with the complex amplitude method for circuits with mutual inductance.	Laboratory work No. 4. Final exam.
Able to perform circuits calculations using circuit simulation software LTSpice (PSpice) and MATLAB for numerical calculations.	Laboratory works No.1. – No. 4.
Can perform harmonic voltage and current amplitude and phase measurements in the laboratory.	Laboratory works No.1. – No. 4.

Evaluation criteria of study results

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

Study subject structure

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