



RTU Course "Fundamentals of Electrical Engineering Theory"

33000 Faculty of Computer Science, Information Technology and Energy

General data

Code	EEE223
Course title	Fundamentals of Electrical Engineering Theory
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Jūlija Maksimkina
Academic staff	Aigars Vītols Jānis Voitkāns Vladimirs Ņikišins Ludmila Lavrinoviča Vairis Janovskis Agris Treimanis
Volume of the course: parts and credits points	1 part, 9.0 credits
Language of instruction	LV, EN
Annotation	Within the study course the student will learn electrical engineering guidelines, laws, methods and techniques of calculation of electrical parameters, analysis of linear circuits and various calculation methods, application of these methods in calculations of linear electrical circuit modes.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide the necessary knowledge and develop an understanding of electromagnetic phenomena and processes found in linear electrical circuits in stationary modes, as well as to provide knowledge about qualitative and quantitative relationships. The tasks of the study course are: 1) to present current, voltage and power calculations in DC and AC circuits (single-phase and three-phase); 2) to provide knowledge on how to represent sinusoidal currents and voltages in a complex plane in the form of vector diagrams, to create a potential topographic diagram of AC circuit points; 3) to introduce resonance and mutual induction phenomena; 4) to present the undesirable effects of higher harmonics on the operating modes of AC circuits and the operation of resonant filters, with the help of which their influence can be reduced.
Structure and tasks of independent studies	1. Preparation of theoretical substantiation of laboratory works and processing of results. 2. Execution of graphoanalytical works (individual homework).
Recommended literature	Obligātā/Obligatory: 1. Dūmiņš I., Tabaks K., Briedis J. u.c. Elektrotehnikas teorētiskie pamati. Stacionāri procesi lineārās ķēdēs, I. Dūmiņa red. Rīga: Zvaigzne ABC, 1999. 301.lpp. 2. Dūmiņš I. Elektrotehnikas teorētisko pamatu laboratorijas darbi. 1.d. RTU Elektrotehnikas institūts, 1999. (arī http://omega.rtu.lv/etp). 3. Elektrotehnikas teorētisko pamatu grafoanalītisko darbu uzdevumi un metodiski norādījumi. 1. d. Rīga:RTU. 4. Elektrotehnikas teorētiskie pamati. Piemēri un uzdevumi. 1.d. Līdzstrāvas ķēdes. Rīga:RPI, 1969. 5. Sinusoidālu strāvu ķēdes. Metodiski norādījumi un uzdevumi praktiskajām nodarbībām. Rīga:RPI, 1977. 6. Trīsfāzu maiņstrāvas ķēdes. Piemēri un uzdevumi. Rīga:RPI, 1976. 7. Elektrisko ķēžu aprēķinu topoloģiskās metodes. Metodiski norādījumi un uzdevumi praktiskajām nodarbībām. Rīga:RPI, 1983. 8. Periodisku nesinusoidālu strāvu ķēdes. Piemēri un uzdevumi. Rīga:RPI. 9. J. A. Brandao Faria Electromagnetic Foundations of Electrical Engineering. Wiley, 2008, 425 pp. 10. M.Ceraolo, D. Polif Fundamentals of Electric Power Engineering - From Electromagnetics to Power Systems. JOHN WILEY & SONS, INC., IEEE PRESS, 2014, 542pp. 11. Isaak D Mayergoyz, Patrick McAvoy Fundamentals of Electric Power Engineering. World Scientific Publishing Company, 2014, 540 / 539pp. Papildus/Additional: 1. Allan R. Hambley, Electrical Engineering, Principles and Application. 2nd edition. – Prentice Hall, New Jersey, 2002, 846pp. 2. John Bird, Electrical and Electronic Principles and Technology, 3d edition. –Elsevier, 2007, 406pp. 3. James W.Nilsson, Susan A.Riedel. Introductory Circuits for Electrical and Computer Engineering. – Prentice Hall, New Jersey, 2002, 554pp. 4. Richard C.Dorf, James A. Svoboda, Introduction Into Electric Circuits, 5th edition. - JaohnWiley&Sons, Inc., 2001, 865 pp. 5. Theodore Wildi. Electrical Machines, Drives and Power Systems, fifth ed., Prentice Hall, 202, 886 pp. 6. Muhammad H. Rashid Power Electronics. Handbook. – Academic Press, London, 2001, 895 pp.
Course prerequisites	Higher mathematics: complex numbers., derivation, integration.

Course contents

Content	Full- and part-time intramural studies	Part time extramural studies
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	Contact Hours	Indep. work	Contact Hours	Indep. work
1. Ohm and Kirchhoff's laws. Linear resistors. Linear energy sources and its equivalent circuits. Power balance.	8	2	4	6
2. Elements of electrical circuits and its division.	3	8	2	9
3. Kirchhoff's laws method, mesh current method and method of potentials of nodes for calculating electric parameters of electric circuits.	10	10	8	12
4. Superposition method, compensation theorem and principle of linearity.	8	6	4	10
5. Thevenin/ Norton analysis. Maximum active power transfer conditions.	6	6	4	8
6. Four terminal circuits and its equivalent circuits.	4	6	2	8
7. Elements of AC circuits. Sinusoidal AC energy sources. Explanation of RMS.	4	3	2	5
8. AC circuit analysis by using phasors and complex impedances. Ohm and Kirchhoff's laws in complex form.	10	6	6	10
9. Voltage and current diagrams, (phasors diagrams) and potential diagrams of the AC circuits.	10	7	5	12
10. Power balance in AC circuits. Maximum energy transfer conditions in AC circuits. Explanation of using wattmeter in AC circuits.	3	4	3	4
11. Conditions of voltage, current resonance. Vector diagrams.	9	9	5	13
12. Mutually coupled coil's aiding and opposing connections. Determination of mutual inductance.	5	7	5	7
13. Transformer equations, input resistance, transmission factor and vector diagrams.	5	7	4	8
14. Three phase system in star connection. The phase sequence detection principle. Three phase power calculations.	9	9	7	11
15. Three phase system in delta connection. Three phase power calculations.	6	6	4	8
16. Symmetrical components of non-symmetrical three-phase system.	8	9	3	14
17. Causes of periodic non-sinusoidal currents. Peculiarities of circuit calculation.	5	7	3	9
18. High harmonics in three-phase systems.	5	6	2	9
19. Safety instruction, safety issues when working with electrical devices.	2	2	2	2
Total:	120	120	75	165

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to calculate currents in a branched DC circuit, draw up a power balance	1. graphoanalytical work. Linear DC circuits. 1. laboratory work. Voltage regulation with a rheostat. Practical lesson. Exam.
Able to find current in one branch of a branched electrical circuit with the help of Thevenin theorem.	4. laboratory work. Thevenin theorem. Practical lesson. Intermediate examination. Exam.
Able to calculate currents in a branched AC circuit, draw a power balance, draw a current vector and voltage topographic diagram.	2. graphoanalytical work. Sinusoidal AC circuits. Practical lesson. Intermediate examination. Exam.
Able to draw a circle diagram in RL, RC series connection at a variable R, L or C value.	5. laboratory work. AC circuits with active and reactive elements. Practical lesson. Exam.
Able to find the voltage and current at the quadrupole output if the voltage and current at the quadrupole input are given.	Practical lesson. Exam.
Able to determine the active, reactive and full power of a load with a wattmeter, voltmeter and ammeter.	5. laboratory work. AC circuits with active and reactive elements. Practical lesson. Intermediate examination. Exam.
Able to determine the characteristics of a passive tow pole circuit: resistance and phase, active and reactive part of resistance, active and reactive part of conductivity.	5. laboratory work. AC circuits with active and reactive elements. Practical lesson. Exam.
Able to determine the values of L or C in the RLC series circuit, at which voltage resonance occurs.	6. laboratory work. Voltage resonance. Practical lesson. Exam.
Able to determine the inductance of two inductively coupled coils.	8. laboratory work. Determination of mutual inductance. 2. graphoanalytical work. AC circuit calculation. Practical lesson. Exam.
Able to determine line and phase currents and voltages and active power in three-phase circuits.	12. laboratory work. Three-phase circuits. 3. graphoanalytical work. Three-phase circuit in star connection. Practical lesson. Intermediate examination. Exam.
Able to determine symmetrical components for an asymmetric three-phase system.	12. laboratory work. Three-phase circuits. Practical lesson. Exam.
Able to distribute periodic non-sinusoidal currents into sinusoidal components.	15. laboratory work. Non - sinusoidal current circuits. Practical lesson. Intermediate examination. Exam.

Evaluation criteria of study results

Criterion	%
Laboratory works	30
Graphoanalytical works	10
Intermediate examination	10
Exam	50
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	9.0	3.0	2.0	1.0		*	