SYLLABUS

Name: ***Introduction to electrical and electronic circuits (MakAu>SI1IEEC19)***
Name in Polish:
Name in English: ***Introduction to electrical and electronic circuits***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma.polsl.pl/rau3/course/view.php?id=80215

Short description:

The course's main objective is to provide basic and advanced knowledge concerning linear and nonlinear direct current (DC) circuits, fundamental laws, principles, and theorems as well as time-domain (s-domain) analysis and description for the first and higher-order circuits. During the course, the students should develop the skills concerning the analysis methods of circuits in the time domain, know how to use simulation software to find the solution.

Description:

Lectures:

1) Circuit variables - basic terms and definitions, classification of electric circuit problems, circuit elements: resistor, sources. Passive/ active sign convention, circuit diagram.

2) Passive two-terminal elements: resistor (Ohm'a law), equivalent resistance, voltmeter, ammeter, practical voltage and current sources, Kirchhoff's laws, voltage/current dividers.

3) Superposition principle. Energy and power conservation principle, two-terminal subcircuit, Thevenin's/Norton's theorem, passive two-terminal subcircuit, the series connection of resistors. Active two-terminal subcircuit. Maximum power transfer theorem. Separation principle (source substitution theorem).

4) Multi-terminal elements. Element description – conductance/resistance matrix. Passive/active multi-terminal element. Three-terminal element (one-port). Analysis of circuits with the multi-terminal element(s).

5) Analysis of complex circuits, node voltage (nodal) analysis.

6) Analysis of nonlinear circuits. Graphical analysis. Conversion to a single-loop circuit. Analysis based on PWL approximation.

7) Transient analysis. Kirchhoff's laws. Passive element relationship: Resistor, capacitor, coil (inductor). Fundamental facts related to simple RC and RL circuits. Capacitor/coil time domain and s-domain models.

8) Transient analysis in the 1st order circuits – zero and non-zero initial conditions – boundary values-based method. Characteristic circuit values and time-domain responses. Practical step, practical pulse.

9) the 1st order circuit – s-domain method. Laplace transform method, capacitor/coil model. Dictionary between s-domain and time domain.

10) Transient analysis in circuits with arbitrary excitation. Transfer function – properties and selected examples: Integrator. Differentiator.

11) 2nd order circuit – s-domain method. Heaviside formula. Natural response. Complete response: natural response + forced response. Higher order circuits.

12) Introduction to computer added simulation software - PSpice tutorial – DC & time domain examples.

13) Dependent (controlled) elements. Arbitrary dependent element – description. Controlled sources – description. Use of controlled sources to element modeling.

14) Transistor. Operational amplifier. Arbitrary three-terminal or two-port element. Analysis of circuits containing controlled sources.

Classes:

1. Simple electric circuits: application of Ohm's law and Kirchhoff's laws; equivalent resistance. Examples of voltage and current dividers, current-voltage relationship for passive elements (resistors/receivers), and active elements (voltage and current sources). Ideal/real voltmeter and ammeter.

2. Passive two-terminal elements (current-voltage characteristics): resistor (equivalent resistance), voltmeter, ammeter. Ideal and real sources (current-voltage characteristic). Simple electric circuits (continuation), e.g. voltage adder. Power dissipation in electric circuits – energy and power preservation principles.

3. Superposition principle. Circuit with two/three sources, incremental analysis, power dissipation using superposition principle.

4. Equivalent active elements (voltage-current arrows and comparison with sources): Thevenin's and Norton's theorems. Calculation of equivalent active elements by: circuit approach, measurements approach, and characteristic approach. Maximum power transfer condition.

5. Nodal analysis method – general approach, exceptions – the balance of power.

6. Transient analysis in the first-order circuits in the s-domain. Zero and non-zero initial conditions – part 1.

7. Transient analysis in the first-order circuits in the s-domain. Zero and non-zero initial conditions – part 2.

8. Preparation for assessment test – exemplary problems.

The number of hours of classes with direct participation of academic teachers or other persons teaching courses and students. Contact hours:

Lecture: 30h

Classes: 30h

Student's own work:

Preparation for classes, weekly tests: 30h

Preparation for assessment: 30h

Computer tests on DLP: 30h

Total workload: 150

Number of ECTS credits: 5

including

Number of ECTS credits covered by the study program to be earned as part of the course taught with the direct participation of academic teachers or other persons teaching courses and students: 2

Bibliography:

- Richard C. Dorf, James A. Svoboda, Introduction to electric circuits, john Wiley & Sons, Inc. (8th edition, 2009)
- Rutkowski J., Circuit Theory, Wydawnictwo Politechniki Śląskiej, Gliwice 2006.
- Allan H. Robbins and Wilhelm C Miller, Circuit Analysis: Theory and Practice, Delmar Cengage Learning; 4 edition (July 19, 2006)

Learning outcomes:

Knowledge
The student knows and understands:
- elements of physics, electrical engineering, and electronics necessary to understand digital technology and rules of functioning of contemporary computers; Know fundamentals laws, theorems and principles of electric circuits (K1A_W05);
- fundamentals of electrical engineering necessary to understand the functioning of electronic units in a computer system; Know analyses methods for linear electric circuits in DC, time-domains (K1A_W06)
- have knowledge about energy stored elements (capacitor, coil) in the first and second-order circuits (K1A_W07).

Skills
The student is able to:
- analyze simple electric circuits in DC, and time domains (K1A_U12);

Social competences:
The student is prepared to:
- plan and perform computer simulations, interpret the obtained results and draw conclusions (K1A_K01);

Assessment methods and assessment criteria:

Lecture
Written tests with open questions or multiple-choice questions. Two tests are related to DC circuits and time domain analysis. Both tests must be passed.
Passing criteria: minimum 50% of correct answers.

The final grade is determined on the basis of the final tests (classes) and quizzes result (on the distance learning platform).

The final grade is calculated based on a weighted average: 0.5 * DC_outcome + 0.5 * Time_Domain_outcome, rounded according to the university grading scale.

The syllabus is valid from the 2024/25 academic year, and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	5	2020/2021-Z	