COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electrical Engineering [N2Eltech2>ELTECH]

Course

Field of study
Electrical Engineering

Year/Semester
1/1

Area of study (specialization)
Smart Measurement Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
10

Other
0

Tutorials
20

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student starting this course should have knowledge of mathematics, physics and circuit theory at the first degree level, as well as the ability to measure electrical quantities and work in a team. He should also have the ability to obtain information from the indicated printed and electronic sources.

Course objective

Provide students with knowledge about: nonlinear elements and circuits, the phenomenon of ferroresonance, block diagrams of circuits, graphs of signal flows. Extension of knowledge in the field of transient analysis methods of linear RLC systems using the Laplace transform. To acquaint the student with the basics of the methods of synthesis of electric circuits and systems. Acquiring the ability to use the state variable method in the analysis of stationary and non-stationary electrical circuits. Getting to know in-depth calculation and measurement methods in electrical circuits.

Course-related learning outcomes

Knowledge:
1. Has knowledge of the methods used to analyze electric circuits in steady and transient states (with linear and nonlinear elements, Lapalce transform, state variable method).

2. Has knowledge of the physical phenomena occurring in advanced electrical circuits.
3. Has knowledge of the development trends in electrical engineering.
4. Has in-depth knowledge of modeling, analysis and synthesis methods for circuits and electrical systems.
5. Knows selected issues related to electromagnetic interactions.

Skills:
1. Has the ability to obtain and critically analyze specialist information from literature and the Internet on issues related to electrical engineering.
2. Is able to work individually and in a team, independently and as a team to solve tasks in the field of in-depth theory of electric circuits.
3. Is able to select the appropriate equipment and make measurements of electrical quantities independently, document them, and then interpret the obtained results and draw conclusions.
4. Can make a critical analysis of complex electrical systems using appropriate tools and methods.

Social competences:
1. Understands the importance of knowledge in solving cognitive and practical problems in the field of electrical engineering.
2. Is aware of the need for self-development in the field of electrical engineering.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified during the exam, which consists of several dozen closed questions and 3-5 open questions with different scores depending on the degree of their difficulty. Passing threshold: 50% of points. The issues on the basis of which the questions are developed will be sent to students by e-mail using the university's e-mail system or through the eKursy system.
The skills acquired during the accounting classes are verified on the basis of tests. Tests consist of 3-4 tasks with different scores depending on the degree of their difficulty. It is possible to earn additional points for activity during classes. Passing threshold: 50% of points.
Passing laboratory exercises is based on the skills, theoretical and practical knowledge necessary to perform the task, verified on an ongoing basis during classes with students and on the basis of written reports on the task performed.

Programme content

Nonlinear circuits of direct and alternating current. Analysis of electrical circuits using the operator method and the state variable method. Synthesis of passive two-phase devices. Modeling electrical circuits using block diagrams and signals flow graphs.

Course topics

Lecture: Creating, transforming and simplifying flowcharts. Mason graphs and rules of graph reduction. Nonlinear DC and AC circuits, methods of their analysis. Nonlinear circuits with ferromagnetic elements (ferroresonance phenomenon). Transient analysis in RLC circuits using the Laplace transform (operator models of electric circuit elements, principles of taking into account initial conditions, basic laws and theorems of circuit theory in operator form). Passive two-point synthesis (basics of the synthesis task, physical feasibility of two-point devices, Cauer's method, Foster's method, canonical schemes of LC, RL and RC systems). Basics of the synthesis of nonlinear circuits. Application of optimization methods for the synthesis of complex electrical systems. The method of state variables in the analysis of stationary and non-stationary electric circuits (basics, creating the equation of state and the output equation for example electrical circuits, methods of limiting the number of equations, methods of solving the equation of state - in the time domain and using the operator method).
Tutorials: Create and simplify flowcharts of signal in electrical circuits. Creation and simplification of signal graphs for electrical circuits. Solving by analytical and graphic methods AC and DC electric circuits with nonlinear elements. Conditions of realizability of immittance in the class of passive twins. Passive two-point synthesis using the Cauer method. Analysis of transient states in electrical circuits with the use of the operator method with the use of basic laws, theorems and methods of circuit theory analysis.
Laboratories: Implementation of exercises in the following topics: non-linear elements, smoothing current ripples, frequency analysis of LC-type quadripoints, symmetrical and asymmetrical 3-phase systems.

Teaching methods

Lecture: multimedia presentation (drawings, photos, animations) supplemented with examples given on the blackboard, initiating discussions during the lecture.
Exercises: solving example tasks on the board, discussions and comments on how to solve the tasks.
Laboratory: detailed review of reports by the lab leader and discussion of comments, demonstrations, team work.

Bibliography

Basic:
1. Bolkowski S., Teoria obwodów elektrycznych, WNT, Warszawa 2015
2. Kurdziel R.: Podstawy elektrotechniki, WNT, Warszawa 1973.
3. Szabatin J., Śliwa E.: Zbiór zadań z teorii obwodów. Część 2, Wydawnictwo Politechniki Warszawskiej, Warszawa 2015.
4. Rawa H., Bolkowski S., Brociek W.: Teoria obwodów elektrycznych. Zadania., PWN, Warszawa 2019.
5. Frąckowiak J., Nawrowski R., Zielińska M.: Teoria obwodów. Laboratorium, Wydawnictwo Politechniki Poznańskiej, Poznań 2017.
6. Bartkowiak R. A., Electric circuit analysis, John Wiley & Sons, New York 1985.
7. Chua L. O., Desoer C. A., Kuh E. S.: Linear and nonlinear circuits, McGraw-Hill Inc., New York 1987.

Additional:
1. Krakowski M.: Elektrotechnika teoretyczna, PWN, Warszawa 1995.
2. Jastrzębska G., Nawrowski R.: Zbiór zadań z podstaw elektrotechniki, Wydawnictwo Politechniki Poznańskiej, Poznań 2000.
3. Czarnywojtek P., Kozłowski J., Machczyński W.: Teoria obwodów elektrycznych w zadaniach, Wydawnictwo Uczelni PWSZ w Kaliszu, Kalisz 2008
4. Mikołajuk K., Trzaska Z.: Zbiór zadań z elektrotechniki teoretycznej, WNT, Warszawa 1978.
5. Rutkowski J., Circuit theory, The Publishing House of the Silesian University of Technology, Gliwice 2006.

Breakdown of average student's workload

	Hours	ECTS
Total workload	127	5,00
Classes requiring direct contact with the teacher	52	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	3,00