# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Selected issues of the electrotechnics

## Course

Field of study
Electrical Engineering

Year/Semester
1/2

Area of study (specialization)

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

## Number of hours

| Lecture | Laboratory classes | Other (e.g. online) |
|---|---|---|
| 20 | 10 | 0 |
| Tutorials | Projects/seminars | |
| 10 | 0 | |

## Number of credit points

4

## Lecturers

Responsible for the course/lecturer:
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Faculty of Control, Robotics and Electrical Engineering

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Responsible for the course/lecturer:

## Prerequisites

The student starting this subject should have knowledge of mathematics, physics and the basics of electrical engineering at the first-cycle level, as well as the ability to measure electrical quantities and work in a team.

## Course objective

Extending information on the methods of transient analysis of linear RLC systems - the use of Laplace transform. To acquaint the student with the basics of methods for the synthesis of electrical circuits and systems. Acquiring the ability to apply the state variable method in the analysis of stationary and non-stationary electrical circuits. Introduction to basic methods of modeling parameters and energy storage.

## Course-related learning outcomes

Knowledge

1. Has in-depth knowledge of the methods of analysis of electrical circuits in steady and transient states (Lapalce transform, state variable method)

2. Has knowledge of the methods of synthesis of electrical circuits and systems

3. Has knowledge of the circuits modeling of the electrochemical energy storage

4. Has knowledge of the use of different types of energy storage depending on the scope of their functionality

Skills

1. Is able to recognize the synthesis task, check its physical resolvability in terms of passive binary components and perform the required calculations

2. Is able to use the operator method to analyze transients in electrical circuits

3. Is able to arrange state and output equations for linear branched electrical circuits

4. Is able to choose the energy storage system based on their working conditions

5. Is able to choose the right equipment and make independent measurements of electrical quantities

Social competences

Is aware of continuous self-improvement, can work in a team

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lecture is verified during the written exam during the examination session. The exam consists of open-ended questions depending on the level of difficulty. Passing threshold: 50% of points. Exam issues are sent to the staroste by e-mail using the university e-mail system 2-3 weeks before the exam date and discussed during the last lecture.

Skills acquired as part of the auditorium exercises are verified during the written test - colloquium on the last exercises. The colloquium consists of scores depending on the level of difficulty. Passing threshold: 50% of points.

Completion of laboratory exercises is based on the skills, theoretical and practical knowledge necessary to complete the task being carried out, verified on an ongoing basis during classes with students and on the basis of written reports on the task

## Programme content

Lecture:

Transient states analysis in RLC circuits using the Laplace transform (operator models of electrical circuit elements, principles of taking into account initial conditions, basic laws and theorems of the theory of

circuits in the operator form). Synthesis of passive two-terminal networks (basics of the synthesis task, physical binary fulfillability, Cauer method, Foster method, energy function, canonical schemes of LC, RL and RC systems). Basics of synthesis of nonlinear circuits. The use of optimization methods for the synthesis of complex electrical systems. The method of state variables in the analysis of electric circuits of the stationary and non-stationary type (basics, creating a state equation and output equation for example electrical circuits, methods of limiting the number of equations, analytical methods of solving the equation of state - in the time domain and using the operator method). Modeling type of electrochemical energy storage, supercapacitors and kinetic. The use of modern energy storage methods in redundancy of power supply systems for electrical circuits.

Auditorium exercises:

Conditions for the implementation of immittance in the class of passive two-terminal networks. Synthesis of passive two-terminal networks using the Cauer method. Transient states analysis in electrical circuits using the operator method using basic laws, theorems and methods of circuit theory analysis.

Laboratories:

Implementation of exercises on the subject of nonlinear elements, smoothing current ripples, frequency analysis two-port network of LC type, branched magnetic circuits.

## Teaching methods

Lecture: multimedia presentation (including drawings, photos, animations, films) supplemented with examples given on the board, especially computational ones. Taking into account various aspects of the issues presented, including: economic, ecological, legal and social. Presenting a new topic preceded by a reminder of the content of the previous lecture and related content known to students in other subjects.

Auditorium exercises: solving sample tasks on the board, initiating discussions on solutions.

Laboratory: detailed review of reports by the laboratory leader and discussions on comments, demonstrations, teamwork.

## Bibliography

Basic

1. Bolkowski S.: Teoria obwodów elektrycznych, WNT, Warszawa 2013.

2. Rawa H., Bolkowski S., Brociek W.: Teoria obwodów elektrycznych. Zadania., PWN, Warszawa 2019.

3. Frąckowiak J., Nawrowski R., Zielińska M.: Teoria obwodów. Laboratorium, Wydawnictwo Politechniki Poznańskiej, Poznań 2017.

4. Leszek Kasprzyk, Wybrane zagadnienia modelowania ogniw elektrochemicznych i superkondensatorów w pojazdach elektrycznych, Poznan University of Technology Academic Journals. Electrical Engineering - 2019, Issue 101, s. 3-55.

5. Fuchs G., Lunz B., Leuthold M., Sauer D. U., Technology Overview on Electricity Storage, RWTH Aachen, 2012.

Additional

1. Krakowski M.: Elektrotechnika teoretyczna, PWN, Warszawa 1973.

2. Kurdziel R.: Podstawy elektrotechniki, WNT, Warszawa 1972.

3. Chua L.O., Desoer C.A., Kuh E.S.: Linear and nonlinear circuits, McGraw-Hill Inc., New York 1987.

4. Czarnywojtek P., Kozłowski J., Machczyński W.: Teoria obwodów elektrycznych w zadaniach, Wydawnictwo Uczelni PWSZ w Kaliszu, Kalisz 2008.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,0 |
| Classes requiring direct contact with the teacher | 50 | 2,0 |
| Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1] | 50 | 2,0 |

[1] delete or add other activities as appropriate