COURSE DESCRIPTION CARD - SYLLABUS

Course name
Circuit Theory [S1AiR2>TO]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
practical

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
30

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

Knowledge: The student should have knowledge of the basics of mathematical analysis, linear algebra as well as physics (electricity and magnetism). Student should know and understand the concept of complex numbers and their use in calculations. Skills: The student should have the ability to solve equations, operations on matrices and complex numbers. The student should have the ability to obtain information from literature. Student should have the ability to actively participate in organized lectures for a large group of people, be aware of the need to expand theoretical and practical knowledge and constantly update acquired knowledge due to dynamic technological and changes in modern technology. Social Competences: The student should also understand the need to expand their competences and constantly update the acquired theoretical and practical knowledge due to the dynamic development of modern technology. Student should be ready to cooperate as part of a team carrying out a laboratory exercise or a joint project.

Course objective

Course objective is to provide students with basic knowledge about phenomena in electrical systems and laws describing electrical circuits.

Course-related learning outcomes

Knowledge:
1. Student has ordered and in-depth knowledge in solving DC and AC circuits [K1_W1]
2. Student has ordered, theoretically founded general knowledge of the theory of electrical circuits and DC and AC electrical engineering (including three-phase); [K1_W6]

Skills:
1. Student is able to use properly selected methods and measuring instruments and to measure relevant signals and on their basis determine the static and dynamic characteristics of automation components and obtain information on their basic properties; [K1_U14]
2. Student is able to build, run and test a simple electronic and electromechanical system; [K2_U15]

Social competences:
1. Student is aware of the need for a professional approach to technical issues, familiarization with the documentation and environmental conditions in which the devices and their components can function; Student is ready to comply with the principles of professional ethics and to require this from others, respecting the diversity of views and cultures; [K2_K5]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Rating:
a) in the scope of lectures, verification of learning outcomes is carried out by:
assessment of knowledge and skills demonstrated during the written test exam (30 questions, no negative points, 1 point per question).
b) in the scope of exercises, verification of assumed learning outcomes is carried out by:
assessment of knowledge and skills demonstrated at two test (3 tasks per test, equally scored)
c) in the scope of laboratories - the average grade from two parts of laboratories. Grades from individual parts based on current grades from laboratory exercises. The condition of passing is obtaining a positive grade from both parts.

Assessment rules (for passing the lecture and tutorials):
3.0 at least 50% points,
3.5 at least 60% points,
4.0 at least 70% points,
4.5 at least 80% points,
5.0 at least 90% points.

Programme content

The lecture includes the key subjects like: Kirchhoff laws, symbolic approach, single and three-phase systems, and the transient analysis.

Course topics

The lecture program includes the following topics:
1. Introduction. Circuit with lumped elements. Kirchhoff"s laws as an application of Maxwell"s equations.
2. Elements R, L, C, M, sources J, E (depend and independ). Differential description. Linear and affine circuits. Kirchhoff"s laws. The principle of superposition. Power and energy.
3. Transformations of circuits - serial and parallel connections, star-delta transfiguration.
4. AC circuits. Symbolic approach for RLC circuits. Power in AC circuits.
5. Methods for analyzing electrical circuits - Thevenin and Norton theorems, equivalence method
6. Topological analysis of electrical circuits, identification of nodes and meshes. Matrix methods: nodal potentials, loop currents solving circuits.
7. Serial and parallel resonance phenomena.
8. Transient states analysis in RL and RC circuits by solving differential equations in time domain.
9. Transient states analysis in RL and RC circuits by solving operator equations. Determining time domain responses.
10. Analysis of transients in the RLC circuit.
11. Analysis of three-phase systems - basic relationships, phasor diagram, power.

12. Three-phase systems - measurement of active, reactive and apparent power, method of symmetrical components.
13. Four-theory theory: four-matrix matrices, four-terminal connections.
Laboratory classes are conducted in the form of 2-hour exercises that take place in the laboratory, preceded by an instructional session at the beginning of the semester. As part of the laboratories, the student will learn the operation of basic devices such as a meter, generator, oscilloscope. Exercises are carried out in groups of 2-4 people. Laboratory classes are divided into two thematic parts and relate to the issues discussed in the lecture.
Classes are conducted in the form of 2-hour exercises during which calculation tasks are solved.
Part of the above mentioned program content is implemented in the student''s own work.

Teaching methods

Teaching methods:
1. lecture: multimedia presentation, examples given on the board, simulations in a Spice program.
2. exercises and laboratories: performing experiments, testing electrical circuits, measuring electrical signals, solving computational problems, discussion, teamwork

Bibliography

Basic:
1. Stanisław Osowski, Krzysztof Siwek, Michał Śmiałek, Teoria Obwodów, Oficyna Wydawnicza Politechniki Warszawskiej, 2006
2. Stanisław Bolkowski, Teoria obwodów elektrycznych, Warszawa, Wydawnictwa Naukowo-Techniczne, 2001
3. Andrzej Cichocki [et al.], Zbiór zadań z elektrotechniki teoretycznej, Warszawa, PWN, 1985
4. Stanisław Bolkowski, Wiesław Brociek, Henryk Rawa, Teoria obwodów elektrycznych : zadania, Warszawa, Wydawnictwo WNT, 2015 (dostępny na platformie ibuk)
5. J. Frąckowiak, R. Nawrowski, M. Zielińska. Podstawy elektrotechniki, Laboratorium

Additional:
1. Maciej Krakowski, Obwody liniowe i nieliniowe, Warszawa, Wydaw. Naukowe PWN, 1999
2. Krzysztof Cieślicki, Andrzej Syrzycki, Zbiór zadań z elektrotechniki ogólnej, Warszawa, Oficyna Wydawnicza Politechniki Warszawskiej, 2007

Breakdown of average student's workload

	Hours	ECTS
Total workload	155	6,00
Classes requiring direct contact with the teacher	92	3,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50