COURSE DESCRIPTION CARD - SYLLABUS

Course name
Applied electrical engineering and electronics

Course

Field of study
Technical Physics

Year/Semester
2/3

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
15

Other (e.g. online)

Tutorials

Projects/seminars
15

Number of credit points

5

Lecturers

Responsible for the course/lecturer:
dr inż. Karol Bednarek

Faculty of Control, Robotics and Electrical Engineering

Institute of Electrical Engineering and Electronics

Piotrowo 3a, 60-965 Poznań

email: karol.bednarek@put.poznan.pl

Responsible for the course/lecturer:

Prerequisites

Knowledge: Basic knowledge of physics and mathematics (general level).

Skills: He can use analytical methods to formulate and solve tasks in the field of determining physical quantities and has the ability to effectively self-educate in the field related to the selected field of study.

Social competences: Able to work responsibly on a designated task independently and in a team.

Course objective

1. Provide students specializing in Technical Physics with knowledge of electrical engineering and

electronics. Familiarizing students with the structure, principles of operation and application possibilities of electrical and electronic devices (lecture).

2. To acquaint students with the principle of operation of specialized measuring equipment, the implementation of research and methods of analyzing the obtained results of measurements (laboratory).

3. Developing students' design skills along with the selection of elements of the designed system in order to achieve optimal solutions, analysis of computer simulation results, preparation of research reports and public presentation of the results and their discussion in the forum (project).

4. Shaping students' teamwork skills (laboratory, project).

Course-related learning outcomes

Knowledge

As a result of the course, the student will have knowledge in the following areas:

1. Knows the mathematical apparatus necessary to describe the basic laws of electrical engineering and to solve problems related to the issues of electrical engineering and applied electronics. [K1_W01].

2. Has a basic knowledge of electrotechnics and electronics, allowing to understand the principles of operation of measuring devices and research apparatus. [K1_W08].

3. Has basic knowledge of metrology, knows and understands methods of measuring physical quantities and analyzing measurement results. [K1_W09].

Skills

As a result of the course, the student will acquire the following skills:

1. Can obtain information from literature, databases and other sources (eg laboratory tests), analyze and interpret them, draw conclusions, also in the case of laboratory tests, justify opinions. [K1_U02].

2. Can work independently and in a team. [K1_U05].

3. Is able to identify a technical problem and then propose a diagram of its analysis and / or solution. [K1_U14].

4. Can use selected computer programs supporting design decisions; can design selected elements and simple structures: mechanical and electronic. [K1_U10].

Social competences

As a result of the conducted classes, the student will acquire the following social competences:

1. Is aware and understands the importance of non-technical aspects and effects of engineering activities, including its impact on the environment and the responsibility for the decisions made. [K1_K06].

2. Is able to properly define the priorities for the implementation of the tasks set by himself or others; is aware of the importance of behavior in a professional manner; is aware of the responsibility for jointly performed tasks related to teamwork. [K1_K07].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Effect	Form of evaluation	Assessment criteria
W01, W08, W09	Lecture. Written or oral exam. Additionally, continuous assessment	50.1%-70.0% (3)
	(rewarding activity and quality of perception during classes).	70.1%-90.0% (4)
U05, U10, U14		from 90.1% (5)
K06, K07	Assessment (completion) of the laboratory.	50.1%-70.0% (3)
	Continuous assessment during each class – rewarding	70.1%-90.0% (4)
	the increase in the ability to use the learned rules	from 90.1% (5)
	and methods, assessment of knowledge and skills	
	related to the implementation of the exercise task,	
	assessment of reports on the exercises performed.	
	Assessment (completion) of the project.	50.1%-70.0% (3)
	Assessment of knowledge and skills related to the implementation	70.1%-90.0% (4)
	of the project task, assessment of answers to questions,	from 90.1% (5)
	the use of simulation methods,	
	the ability to analyze results and draw conclusions.	

Programme content

Lecture:

Basic concepts of electrotechnics, basics of electrostatics, circuit elements, laws of electrical circuits, matching the receiver to the source for maximum power, basics of magnetism and electromagnetism, types of materials due to electrical and magnetic interactions, the formation of sinusoidal voltage, physical quantities and electrical parameters in AC circuits, methods of analyzing DC and sinusoidal current circuits (outline methods: Kirchhoff's laws, superposition, loop currents, nodal potentials), circuit theorems (Thevenin, Norton, Tellegen, on reciprocity and compensation), power and energy in sinusoidal variable circuits , RLC elements (phasor diagrams), voltage and current resonance, reactive power compensation, power and energy measurements in electric circuits. Creation and properties of three-phase systems. System analysis in the case of distorted excitations (application of the Fourier

series, RMS current and voltage, powers: active, reactive, apparent, distortion, harmonics). Basic electronic components: diodes, transistors, thyristor, hall effect sensor, thermistor, varistor, photo-optical elements. Selected electronic systems: rectifiers and filters, amplifiers, vibration generators, power supplies, etc. Measuring instruments and methods in electrical engineering. Measurements of selected non-electrical quantities using electrical methods (sensors and their applications in industry and vehicles). Mutual electromagnetic interactions of devices – electromagnetic compatibility (problem outline). Transformers and rotating machines – structure, principle of operation, design solutions, functional properties.

Laboratory:

Study of DC circuits containing linear and nonlinear elements. Testing rectifiers and filter systems. Measurements of power and energy in single-phase systems. AC circuits with RLC elements. Investigation of electrical properties of light sources. Selected laws of electrical engineering in DC circuits.

Project:

Presentation of the practical application of software for designing and simulating electrical and electronic systems. Overview of the LTSpice simulation environment, presentation of creating projects and conducting simple simulations. Presentation of the KiCad software for designing printed circuits along with a presentation of the method of project implementation. Student's own creation of simulations and designs for elementary electric and electronic circuits.

Teaching methods

Lecture:

The lecture with blackboard or multimedia presentation (including drawings, photos, animations, films), taking into account various aspects of the issues presented, including: economic, ecological, legal, social and practical examples known to students in everyday life. Presenting a new topic preceded by a reminder of the content of the previous lecture. Presenting material in connection with other objects.

Laboratory:

Practical exercises, conducting experiments, discussion, team work.

Project:

Individual student project work, discussion.

Bibliography

Basic

1. Bolkowski S.: Teoria obwodów elektrycznych, WNT, Warszawa 2017, (dowolne wydanie).

2. Kurdziel R.: Podstawy elektrotechniki, WNT, Warszawa 1973.

3. Krakowski M., Elektrotechnika teoretyczna, tom 1 – Teoria obwodów (tom 2 - Pole elektromagnetyczne), PWN, Warszawa 1999, (dowolne wydanie).

4. Nawrocki W.: Elektronika: układy elektroniczne, Wydawnictwo Politechniki Poznańskiej, Poznań 2010.

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

6. Pr. zbior. Elektrotechnika i elektronika dla nieelektryków, WNT, W-wa 1999 (1995, 1991).

7. Bolkowski S., Brociek W., Rawa H., Teoria obwodów elektrycznych. Zadania., WNT, 2015.

8. Majerowska Z., Majerowski A., Elektrotechnika ogólna w zadaniach, PWN, W-wa 1999 (1984).

Additional

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

2. Hempowicz P. i in., Elektrotechnika i elektronika dla nieelektryków, WNT, W-wa, 2004 (1999).

3. Charoy A., Zakłócenia w urządzeniach elektronicznych. Zasady i porady instalacyjne, cz. 1-4, z serii: Kompatybilność elektromagnetyczna, WNT, Warszawa 1999-2000.

3. Opydo W., Elektrotechnika i elektronika dla studentów studiów zaocznych wydziałów nieelektrycznych politechnik, skrypt Politechniki Poznańskiej nr1757.

4. Opydo W., Kulesza K., Twardosz G.: Urządzenia elektryczne i elektroniczne. Przewodnik do ćwiczeń laboratoryjnych, Wydawnictwo Politechniki Poznańskiej 2002.

5. Szabatin J., Śliwa E., Zbiór zadań z teorii obwodów, WPW, 2008.

6. Bednarek K., Elektromagnetyczne oddziaływania i bilans energetyczny w sieci zasilającej w budynku banku, Przeglad Elektrotechniczny, 90 (2014), nr 12, 188-191.

7. Putz Ł., Bednarek K., Nawrowski R., Disturbances Generated by Lighting Systems with LED Lamps and the Reduction in Their Impacts, Applied Sciences, Vol. 9, issue 22, 2019, p. 1-18, DOI: 10.3390/app9224894.

8. Praca zbiorowa: Czujniki w pojazdach samochodowych. Informatory techniczne Bosch, WKiŁ, Warszawa 2014.

9. Bednarek K., Bugała A., Budzińska N., Wielogórski M., Stanowiska do badań i prezentacji funkcjonowania czujników prędkości obrotowej oraz położeń liniowych i kątowych, Poznan University of Technology Academic Journals, Electrical Engineering, No 100, Poznań 2019, s. 199-210, DOI: 10.21008/j.1897-0737.2019.100.0018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	126	5,0
Classes requiring direct contact with the teacher	66	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	100	4,0

[1] delete or add other activities as appropriate