COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of electronics [S1AiR2>PE]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

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
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Knowledge: A student starting this subject should have a basic knowledge of electrical engineering (especially circuit theory), programming and computer skills. Skills: She or he should have the ability to solve systems of linear equations and analyze basic electrical circuits, calculate elementary derivatives and integrals. A student should also be able to use basic computer tools. She or he should also understand the need to expand her/his competences and be ready to cooperate in a team. Social competences: In addition, she or he should exhibit qualities such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture and respect for other people.

Course objective

1. Providing students with knowledge of basic electronic components, their structure and properties as well as basic analog and digital electronic circuits. 2. Developing students" skills in testing and designing electronic circuits. 3. Developing students" teamwork skills in performing laboratory exercises.

Course-related learning outcomes

Knowledge:
1. A student has structured and theoretically founded knowledge of the principles of operation of basic electronic, analog and digital components, selected electronic circuits and systems - [K1_W12]

Skills:
1. A student can read and understand design technical documentation and simple technological diagrams of automation and robotics systems - [K1_U2]
2. A student is able to build, run and test a simple electronic circuit - [K1_U15]
3. A student is able to design simple electrical and electronic circuits intended for various applications - [K1_U25]

Social competences:
1. A student understands the need and knows the possibilities of continuous training - raising professional, personal and social competences, she or he is able to inspire and organize the learning process of other people - [K1_K1]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
a) in the scope of lectures:
based on answers to questions about the material discussed in previous lectures, tests checking understanding of the lecture content at the end of selected lectures
b) in the scope of laboratories / tutorials:
based on an assessment of the current progress of task implementation.
Summative assessment:
a) in the scope of lectures: the verification of the assumed learning outcomes is carried out by:
i. assessment of knowledge and skills demonstrated during the written exam consisting of 4 problem tasks;
ii. discussion about exam results,
b) in terms of tutorials, verification of the assumed learning outcomes is carried out by: assessing the student"s preparation for individual classes, continuous assessment, at each class (oral answers) - rewarding the increase in the ability to use the learned principles and methods, assessment of solving tasks partially solved during classes and partially after their completion, the assessment of knowledgeand skills related to solving tasks through a final test
c) in the scope of laboratories: verification of assumed learning outcomes is carried out by:
i. assessment of student"s preparation for individual sessions of laboratory classes ("entrance" test) and assessment of skills related to the implementation of laboratory exercises,
ii. continuous assessment, during each class (oral answers) - rewarding the increase in the ability to use known principles and methods,
iii. assessment of the laboratory reports prepared partly during the classes and partly at home; this assessment also includes teamwork skills.
Obtaining additional points for activity during classes, in particular for:
i. discuss of additional aspects of the issue,
ii. effectiveness of applying the acquired knowledge while solving a given problem,
iii. ability to work as part of a team that practically performs a specific task in the laboratory,
iv. comments related to the improvement of teaching materials,
v. indicating students" perceptive difficulties enabling ongoing improvement of the didactic process.

Programme content

The program introduces issues related to modern electronics, familiarizes students with production technologies of electronic components and systems, basic properties and applications of selected electronic components, including passive components, diodes, transistors and operational amplifiers, and basic analog and digital electronic systems.

Course topics

The lecture program includes the following topics:

1. Introduction: design of electronic devices, surface mounted (SMT) and THT (through-hole) technologies, RoHS directive, technologies, EDA, software and equipment used in the laboratories: NI LabVIEW, ELVIS II
2. Semiconductor phenomena (metals, semi-metals, non-metals; conductors, semiconductors, insulators, charge carriers in semiconductors, p-n junction, a diode)
3. Semiconductor electronic components: thermistors, varistors, semiconductor diodes, optocouplers
4. Bipolar junction transistors (BJT) and field-effect transistors (FET), construction, operating conditions, transport model, Ebers-Moll model, characteristics
5. Basic transistor circuits: transistor as a switch, inverter, transmission gate, CMOS circuits, TTL circuits
6. Power supplies and linear voltage and current regulators
7. Transistor amplifiers, the concept and methods of analysis of an ideal operational amplifier
8. Switching circuits: half bridge, H-bridge, switching regulators and switching power supplies
9. Power amplifiers: basic analysis of linear amplifiers, class of amplifiers
10. Power amplifiers: practical solutions, switching amplifiers
11. Electronic circuits with feedback: amplifiers with feedback, circuits with operational amplifiers, generators
12. Operational amplifiers: examples of applications, types, parameters, electronic compensation
13. Passive electronic components: resistors, capacitors, coils, transformers, relays, switches
14. Computer-aided design (CAD) and implementation of electronic circuits
15. Power electronic elements: thyristors, triacs, power transistors

The tutorials program includes the following topics:
1. Basic parameters of signals in electronic systems
2. Diode circuits
3. Bipolar transistor polarization, operating point
4. Continuous power supplies
5. Switching power supplies
6. Operational amplifiers - linear circuits
7. Operational amplifiers - nonlinear circuits

Laboratory classes are conducted in the form of fourteen 2-hour exercises taking place in the laboratory, preceded by a 1-hour instructional session at the beginning of the semester and a 1-hour summary at the end of the semester. Exercises are carried out by teams of 2 students.
The laboratory program includes the following issues:
1. Introduction to the LabVIEW environment and the ELVIS II platform
2. P-n junction (semiconductor diodes)
3. Bipolar transistor
4. Field effect transistor
5. Operational amplifier in basic linear circuits
6. Project 1: diode-transistor, assumptions, simulation
7. Project 1: diode-transistor, commissioning, measurements, presentation
8. Introduction to the LTspice simulator
9. Rectifiers, ripple suppression
10. Stabilizer with Zener diode, surge suppression, protection
11. Transistor in digital systems (key, transmission gate, inverter)
12. Transistor amplifier (bipolar transistor)
13. Operational amplifier - simulation
14. Project 2: operational amplifier application, assumptions, simulation
15. Project 2: operational amplifier application, commissioning, measurements, presentation

Teaching methods

1. Lecture: multimedia presentation illustrated with examples on the board.
2. Practical classes: solving tasks, problem-solving, case studies.
3. Laboratory classes: configuration of measuring systems (hardware and software), performing of measurements, teamwork.

Bibliography

Basic:
1. Teaching materials on the www.dsp.put.poznan.pl website
2. Sztuka elektroniki, cz. 1 i 2, P. Horowitz, W. Hill, WKiŁ, Warszawa 2009
3. U.Tietze, Ch.Schenk: Układy półprzewodnikowe, WNT 2008

Additional:
1. Układy elektroniczne cz. I. Układy analogowe liniowe, Z. Nosal, J. Baranowski, WNT, Warszawa 1994
2. Układy elektroniczne cz. II. Układy analogowe nieliniowe i impulsowe, J. Baranowski, G. Czajkowski, WNT, Warszawa 2004
3. Układy elektroniczne cz. III. Układy i systemy cyfrowe. J. Baranowski, B. Kalinowski, Z. Nosal, Warszawa 1998

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	48	2,00