COURSE DESCRIPTION CARD - SYLLABUS

Course name
Practical electronics [N2AiR1-SW>PO2-EP]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

Area of study (specialization)
Vision Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
20

Laboratory classes
10

Other (e.g. online)
0

Tutorials
0

Projects/seminars
10

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: A student starting this subject should have a basic knowledge of the theory of circuits, electronic components and systems, the basics of analog and digital electronics. Skills: A student should have the ability to solve basic problems in the design of electronic circuits and the ability to obtain information from specified sources. 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. To provide students with knowledge of the design, use and maintenance of modern digital and analog electronics circuits and systems. 2. Developing students' ability to solve problems related to the implementation of projects of the electronic circuits. 3. Developing students' teamwork skills in implementing projects of the electronic circuits.

Course-related learning outcomes

Knowledge

1. A student has specialized knowledge of remote and distributed systems, real-time systems and network techniques, - [K2_W3]
2. A student understands the design methodology for specialized analog and digital electronic systems, - [K2_W4]
3. A student has knowledge of adaptive systems, - [K2_W9]
4. A student knows the basic parameters of electrical and electronic components and knows how to choose them for selected applications - [-]
Skills
1. A student is able to analyze and interpret the project technical documentation and to use scientific literature related to a given problem, - [K2_U2]
2. A student is able to use information and communication techniques, - [K2_U8]
3. A student is able to make a design of an electronic circuit with a printed circuit board in a computer aided design system - [-]
Social competences
1. A student is aware of the need for a professional approach to technical issues, meticulous reading of documentation and knows environmental conditions in which devices and their components can function - [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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
b) in the scope of laboratories:
based on an assessment of the current progress of task implementation.
c) in the scope of project classes:
based on an assessment of the current progress of tasks 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 on the multiple-choice written test (15-20 test questions), 2-3 open questions and a problem task; on the test the student can get 23 points, for a positive grade she or he must get at least 12 points,
ii. discussion about test results,
b) 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 lecture program includes the following topics:
1. Introduction: design of electronic devices, description of the device design process, selection of the implementation platform, discrete components, glue-logic components, programmable logic devices (PLDs), FPGAs, microprocessor systems, system on chip (SoC), technologies of manufacturing of digital programmable systems: CMOS, HKGM (High-k and Metal Gate), alternative technologies, manufacturing process, wafer, device manufacturing techniques, assembly: through-hole technology (THT), surface

mounting technology (SMT), RoHS directive, development of digital integrated circuits.
2. Passive electronic components: selection, parameters, applications, E series.
3. Semiconductor electronic components
4. Electronic design automation (EDA) software: the Altium Designer environment, the basics of designing of printed circuit boards (PCBs).
5. Power amplifiers - solutions, circuits, problems
6. Overcurrent protection: fuses, polymer fuses, circuit breakers, current-time protection characteristics, methods for measuring of the protection components, selection of protection devices.
7. Overvoltage suppression: assembly problems, overvoltage sources, energy exchange between inductance and capacity, overvoltage from lightning, surge suppressors: types, selection, areas of application.
8. Cooling of electronic components: heat sinks, a concept of the thermal resistance, the impact of cooling by radiation, calculations of natural and forced cooling systems, Peltier elements.
9. DisruptionS in electronic systems: the concept of near and far field, magnetic and electric component of the electromagnetic field, interference suppression and shielding of electronic systems, problems of ground loop, shielding of wires, influence of cable type on the emission and reception of interference, types of screens, methodology of screen calculations, construction of screens and signal outputs from the shielded area.
10. Noise in electronic systems: types of noise, sources of its formation, methods of minimizing noise in electronic systems.
11. Power supplies: non-stabilized 1-phase, 3-phase circuits, properties, characteristics, linear voltage and current regulators: circuits, properties, characteristics.
12. Basics of switched-mode energy conversion: types of switched-mode power supply systems, DC / DC converter, principle of operation of uninterruptible power supply (UPS).
13. Usage, diagnostics and repair of electronic systems: service and repairprocedures, testing of electronic components and devices, service instructions.
14. Hardware / software (HW-SW) co-design: techniques for designing of reliable systems, embedded systems, team design, increasing system performance, architecture optimization, task location in functional blocks, self-repairing integrated circuits.
15. Summary: trends in the design of electronic devices, key integrated circuits and "milestones" in the development of electronics, trends in the design of systems on chip (SoCs).

Laboratory classes are conducted in the form of seven 2-hour exercises that take place in the laboratory, preceded by a 1-hour instructional session at the beginning of the semester. Exercises are carried out by 2-person teams.

The program of laboratory classes includes the following issues:
1. Introduction to the printed circuit board (PCB) design: Altium Designer environment, hierarchical design, project layers, connection layers (copper), solder mask, vias, solder pads.
2. Altium Designer environment: types of electronic components: housings. types of integrated circuit cases, creation of library elements.
3. Simulation of analog circuits on the example of active filters
4. Routing of printed circuit boards (PCB): settings of autorouterregarding the circuit complexity
5. Designing of digital circuits using programmable elements: the use of Nanoboard 2 prototype boards, graphic description fo the system and connections, FPGA matrix systems.
6. Powerbank: operating principle, circuitry and components of a portable, battery power source
7. Soldering of components in through-hole technology (THT) and surface mounting technology (SMT): types of component housings, circuit board construction, components sensitivity to electrostatic discharge, soldering stations, soldering ramp, RoHS directive, leaded and lead-free soldering, fluxes.
Project classes are conducted in the form of seven 2-hour meetings held in the laboratory and a 1-hour organizational meeting. Projects are implemented by 1 or 2-person teams.
The purpose of the first 2 classes is to determine the assumptions of the electronic circuit design, its functionality and to choose the hardware and software platform that performs the required tasks. During further classes the students carry out the design tasks, preparation and implementation of the equipment, write software and project documentation.

Teaching methods

1. Lecture: multimedia presentation illustrated with examples on the board, solving of tasks

2. Laboratory classes: configuration of measuring systems (hardware and software), performing of measurements, teamwork
3. Project classes: circuits designing, teamwork

Bibliography

Basic
1. Sztuka elektroniki, część 1 i 2, Horowitz P., Hill W., WKŁ, Warszawa, 2009
2. U.Tietze, Ch.Schenk: Układy półprzewodnikowe, WNT 2008
Additional
1. Zakłócenia w aparaturze elektronicznej, Hasse L., Kołodziejski J., Spiralski L. i in., Radioelektronik sp. z o.o., Warszawa, 1995
2. Metody redukcji zakłóceń i szumów w układach elektronicznych, Ott H.W., WNT, Warszawa, 1979

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50