COURSE DESCRIPTION CARD - SYLLABUS

Course name
Designing electronic circuits

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

Area of study (specialization)
Vision systems

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

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

A student:

1. understands the design methodology for specialized analog and digital electronic systems, - [K2_W4]

2. has knowledge of adaptive systems, - [K2_W9]

3. knows the basic parameters of electrical and electronic components and knows how to choose them for selected applications - [-]

Skills

A student:

1. is able to analyze and interpret the project technical documentation and to use scientific literature related to a given problem, - [K2_U2]

2. is able to use information and communication techniques, - [K2_U8]

3. 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:

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: designing of modern electronic devices, description of the electronic systems and circuits design process, selection of the design environment, discrete elements, glue-logic, digital programmable circuits PLD, FPGA, microprocessor systems, system in a circuit (SoC), technologies of manufacturing of digital programmable circuits (CMOS), HKGM (High-k and Metal Gate) , alternative technologies,manufacturing process, wafer, device manufacturing techniques, assembly technologies:

through hole technology (THT), surface mounting technology (SMT), RoHS directive, development of digital integrated circuits.

2. Passive and semiconductor electronic components: selection, parameters, applications.

3. Electronic design automation (EDA) software: Altium Designer, the basics of printed circuit board (PCB) design.

4. Designing low-power circuits and energy-saving systems.

5. Designing switched-mode circuits: power amplifiers, switched-mode power supply systems, switched-mode voltage regulators, inverters. Overcurrent and overvoltage protection elements and circuits.

6. Designing cooling of electronic components: heat sinks, a concept of thermal resistance, the effect of cooling by radiation, calculations of natural and forced cooling systems, Peltier elements. Elimination of interference in electronic circuits, methods of minimizing noise in electronic systems.

7. Hardware and software co-design (HW-SW co-design): techniques for designing of reliable systems, embedded systems, designing in a team, increasing system performance, optimization of architectures, locating tasks in functional blocks, self-repairing integrated circuits.

8. Summary: trends in the development of electronic devices, key integrated circuits and "milestones" in the development of electronics.

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 autorouter depending on the complexity of the design

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	75	3
Classes requiring direct contact with the teacher	45	2
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	30	1

[1] delete or add other activities as appropriate