COURSE DESCRIPTION CARD - SYLLABUS

Course name

FPGA systems in control

Course

Field of study

Automatic Control and Robotics

Area of study (specialization)

Control and Robotics Systems

Level of study

Second-cycle studies

Form of study

full-time

Year/Semester

1 / 1

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

12

Tutorials

-

Laboratory classes

12

Projects/seminars

-0

Other (e.g. online)

-

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

dr inż. Rafał Kapela

email: Rafal.Kapela@put.poznan.pl

tel. 61 6652184

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:

dr inż. Adam Turkot

email: Adam.Turkot@put.poznan.pl

tel. 61 6652504

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3, 60-965 Poznań

Prerequisites

Students starting this subject should have basic knowledge of programming, computer system architecture, digital electronics, and computer skills. Should have the ability to use the design environment provided by electronic equipment manufacturers such as Mentor Graphics (Modelsim) or Xilinx (ISE, Vivado). He should also understand the need to broaden his competences

/ be willing to cooperate within a team. In addition, in the field of social competence, the student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The purpose of the education module:

1. Ability to implement peripheral modules on an embedded platform (eg, Zynq) in hardware description language (VHDL).
2. Ability to functional verification of written hardware modules in Modelsim / Questa environment.
3. Ability to implement Linux operating system drivers for designed devices.

Developing students' teamwork skills through the implementation of project elements and combining them into a whole.

Course-related learning outcomes

Knowledge

1. understands the design methodology for specialized analog and digital electronic systems; - [KW_4]

2. has detailed knowledge of the construction and use of advanced sensory systems; - [KW_6]

4. has ordered and in-depth knowledge related to control systems and control and measurement systems; - [KW_11]

Skills

1. can use advanced methods of signal processing and analysis, including video signal and extract information from the analyzed signals; - [KU_11]

2. is able to select and integrate elements of a specialized measuring and control system including: control unit, executive system, measuring system as well as peripheral and communication modules; - [KU_13]

3. can assess the usefulness and possibility of using new achievements (including techniques and technologies) in the field of automation and robotics; - [K_K16]

4. can design control systems for complex and atypical multidimensional systems; is able to consciously use standard functional blocks of automation systems and shape dynamic properties of measuring tracks; - [KU_27]

Social competences

1. is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions; is ready to develop his professional heritage; - [K_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in terms of lectures: based on answers to questions about the material discussed in previous lectures,

b) in the scope of laboratories / exercises: based on the assessment of the current progress of tasks,

Summative rating:

a) in the scope of lectures, verification of assumed learning outcomes is carried out by:

i. assessment of knowledge and skills demonstrated during the problem-type written exam consisting of 5 questions out of 40 questions presented on the general list of questions, previously provided to students.

Grading rules:

5.0 - above 90% of exam points (W); average of grades from lab exercises above 4.75 (L)

4.5 - 80% -90% of exam points (W); average of grades from lab exercises 4.25-4.75 (L)

4.0 - 70% -80% of exam points (W); average of grades from lab exercises 3.75-4.25 (L)

3.5 - 60% -70% of exam points (W); average of grades from lab exercises 3.25-3.75 (L)

3.0 - 50% -60% of exam points (W); average of grades from lab exercises 2.75-3.25 (L)

2.0 - less than 50% of exam points (W); average grades from lab exercises below 2.75 (L)

ii. discussion of passing results,

b) in the scope of laboratories / exercises, verification of assumed learning outcomes is carried out by:

a. assessment of student's preparation for individual laboratory sessions (entrance test)

b. assessment of the laboratory exercise carried out (report)

Programme content

The lecture program includes the following topics:

1. VHDL language.
2. Programmable system architecture (CPLD, FPGA).
3. Interfaces of peripheral systems - AXI, AXI Lite, AXI Stream, I2C, etc.
4. Implementation of a simple processor peripheral device in an FPGA matrix.
5. Use in the design of digital systems of Xilinx programs (ISE, Vivado).

Laboratory classes are conducted in the form of 2-hour exercises that take place in the laboratory, preceded by a 2-hour instructional session at the beginning of the semester. The initial part of the laboratory consists of exercises carried out by teams of 1 students according to exercises selected by the teacher and given in the script to the laboratory. In the middle of the semester, students are issued descriptions of projects to be implemented as part of the exercises. Projects are implemented individually or in teams of 2, depending on the expected difficulty of project implementation.

The laboratory program includes the following issues:

1. Simulation of simple digital systems in the ISE application.
2. Preparation of the FPGA matrix programming file in the Vivado application
3. Basics of programming peripheral device drivers.
4. Debugging drivers.
5. Implementation of a simple processor peripheral device in an FPGA matrix.
6. Implementation of a simple driver for a dedicated peripheral device for the Linux operating system.

Part of the above-mentioned program content is implemented in the student's own work.

Teaching methods

Teaching methods:

1. lecture: multimedia presentation, presentation illustrated with examples given on the board, as well as multimedia shows and demonstrations using, among others ISE program, Vivado
2. laboratory exercises: simulation of digital systems written in VHDL, construction of a simple pulse counting system on the FPGA platform, discussion, teamwork, multimedia show, workshops.

Bibliography

Basic

1. Projektowanie układów cyfrowych z wykorzystaniem języka VHDL, Mark Zwoliński.

2. Linux w systemach embedded, Marcin Bis, Wydawnictwo BTC, ISBN: 978-83-60233-74-0, 2011.

3. Język VHDL. Projektowanie programowalnych układów logicznych. Kevin Skahill, ISBN: 8320429749, WNT 2004.

Additional

1. Wbudowane systemy mikroprocesorowe, Aleksander Timofiejew, Siedlce: Wydawnictwo Akademii Podlaskiej, ISBN: 978-83-7051-579-9, 2010.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2
Classes requiring direct contact with the teacher	25	1
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	25	1

1 delete or add other activities as appropriate