COURSE DESCRIPTION CARD - SYLLABUS

Course name

Microprocessor systems

Course

Field of study	Year/Semester
automatic control and robotics	2/4
Area of study (specialization)	Profile of study
	general academic
Level of study	Course offered in
First-cycle studies	polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	30	
Tutorials	Projects/seminars	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

Knowledge: A student starting this subject should have basic knowledge of electronics and basic programming.

Skills: The student should have the ability to solve basic problems in the field of digital signal processing and the ability to obtain information from specified sources. He should also understand the need to expand his competences and be ready to cooperate in a team.

Social competences: In addition, in the area of social competences, the student must exhibit such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. To provide students with basic knowledge about the architecture and programming of microcontrollers.

2. Developing students' skills to solve problems related to data processing and communication using interfaces in microprocessor electronic systems.

3. Developing the importance of knowledge of standards and recommendations related to the construction and programming of microprocessor electronic devices in students.

Course-related learning outcomes

Knowledge

1. Student has ordered knowledge of computer architectures, computer systems and networks as well as operating systems including real-time operating systems - [K1_W9]

2. knows and understands at an advanced level the theory and methods in the field of architecture and programming of microprocessor systems, knows and understands selected languages of high and low level programming of microprocessors; knows and understands the principle of operation of basic peripheral modules and communication interfaces used in microprocessor systems - [K1_W13]

3. knows and understands typical engineering technologies, principles and techniques for constructing simple automation and robotics systems; knows and understands the principles of selection of executive systems, computational units as well as measuring and control elements and devices - [K1_W20]

Skills

1. The student is able to read the design technical documentation and simple technological diagrams of automation and robotics systems - [K1_U2]

2. is able to use selected tools for rapid prototyping of automation and robotics systems - [K1_U13]

3. is able to choose the type and parameters of the measuring system, control unit and peripheral and communication modules for the selected application and integrate them in the form of the resulting measurement and control system - [K1_U22]

4. is able to construct an algorithm for solving a simple measurement and control task as well as implement, test and run it in a selected programming environment on a microprocessor platform - [K1_U27]

Social competences

1. The student is ready to critically assess his knowledge, understands the need and knows the possibilities of continuous training - raising professional, personal and social competences, is able to inspire and organize the learning process of other people - [K1_K1]

2. is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which the devices and their components can

function; is ready to comply with the principles of professional ethics and to require this from others, respecting the diversity of views and cultures; - [K1_K5]

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 the laboratory:

based on assessment of knowledge and understanding of current issues presented in the course of the subject.

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 written test in the form of a test

ii. discussion of test results.

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

i. assessment of student's preparation for individual classes,

ii. continuous assessment, during each class (oral answers) - rewarding the increase in the ability to use known principles and methods,

iii. assessment of reports prepared partly during classes and also after their completion.

Obtaining additional points for activity during classes, in particular for:

i. independent construction of an electronic module with a microprocessor and preparation of documentation

ii. effectiveness of applying the acquired knowledge while solving a given problem

iii. comments related to the improvement of teaching materials.

Programme content

The lecture program covers the following topics:

1. (Digital logic) Basic logical operations - Boolean algebra. Software and hardware implementation of logical operations.

2. (Combinational circuits) Software and hardware implementation of combinational circuits. Minimization of logical expressions.

3. (Digital Operations) Basic bitwise operations. Number coding systems. Bit masks. Decomposing and composing multibyte numbers with the use of bit masks and data structures. Implementation of converting Gray code to binary code. Introduction to handling microcontroller registers.

4. (Digital circuits) Software and hardware implementation, incl. multiplexers, demultiplexers, flip-flops and memory.

5. (Sequential circuits) Software and hardware implementation of sequential circuits.

6. (Interface) Standard data types in microprocessor systems. Arithmetic in microprocessor systems with finite precision. Calculations using data structures.

7. (Interface) Construction of a simple user interface presenting the results of calculations. Convert numbers to text and text to numbers. Special signs. Conversion of selected data types.

8. (Interface) Math functions. Create user interface pages. Scroll through the pages of the interface.

9. (Interface) User interface based on a sequential layout. User menu implementation.

10. (Communication) Information exchange between the microcontroller and another device, e.g. a computer. Preparation of the application for data exchange.

11. (Communication) Construction of selected communication protocols, eg Modbus.

12. (Hardware layer) Designing electrical schematics and PCB mosaics for digital circuits.

13. (Hardware layer) Designing basic electrical schematics and PCB mosaics for microprocessor systems.

14. (Hardware layer) Internal structure and features of digital circuits. Dynamics and lags of electronic circuits.

15. Summary.

The program of laboratory classes covers the following topics:

1. Organizational classes - familiarization with the equipment and footnotes of OHS, introduction to design environments.

2. Software and hardware implementation and verification of logical operations.

3. Software and hardware implementation and verification of combinational circuits.

4. Program implementation and verification of bit operations. Decomposing and composing multibyte numbers with the use of bit masks and data structures. Introduction to handling microcontroller registers.

5. The use of multiplexers, demultiplexers, flip-flops and memory for the implementation of a selected digital system, eg expansion card of a rotary-pulse / code converter for a microprocessor system.

6. Software and hardware implementation of sequential circuits.

7. Analysis of arithmetic in microprocessor systems of finite precision. Use of simple and complex data structures.

8. Construction of user interface fragments presenting the results of calculations, incl. converting numbers to text and text to numbers with different formatting.

9. Implementation of user menu (eg calculator) based on a sequential system.

10. Preparation of the application for data exchange between the microcontroller and another device, eg a computer.

11. Expansion of the communication channel for bidirectional transmission in a given mode, eg text or binary.

12. Preparation of electrical diagrams for digital circuits, eg expansion card of a rotary-pulse / code converter for a microprocessor system.

13. Preparation of a PCB mosaic for digital circuits, eg an expansion card of a rotary-pulse / code converter for a microprocessor system.

14. Extension of electrical diagrams and PCB mosaic with a microprocessor system.

15. Presentation of the final task: microprocessor system of a simple user interface or communication interface.

Teaching methods

1. Lecture: multimedia presentation illustrated with computer simulations

2. Laboratory classes: the use of STM microprocessor development modules, IDE programming environments, digital circuit verification environment.

Bibliography

Basic

1. Geoffrey Brown, Discovering the STM32 Microcontroller, 2016

2. Donald S. Reay, Digital Signal Processing Using the ARM Cortex M4, 2015

3. Dogan Ibrahim, Microcontroller Based Applied Digital Control, 2006

4. Technika cyfrowa : zbiór zadań z rozwiązaniami / Jerzy Tyszer, Grzegorz Mrugalski, Artur Pogiel, Dariusz Czysz. 2016

Additional

1. D. Łuczak, A. Wójcik, DSP implementation of state observers for electrical drive with elastic coupling , Przegląd Elektrotechniczny R.92 nr 5, s. 100-105, 2016.

2. M. Szumski, Mikrokontrolery STM32 w systemach sterowania i regulacji, BTC, 2018.

3. A. Kurczyk, Mikrokontrolery STM32 dla początkujących, BTC, 2019.

4. K. Paprocki, Mikrokontrolery STM32 w praktyce, BTC, 2009.

5. P. Hadam, Projektowanie systemów mikroprocesorowych, BTC, 2004.

6. Łuczak D., Nowopolski K., Siembab K., Wicher B.: "Speed calculation methods in electrical drive with non-ideal position sensor", Proc. Of the 19th International Conference on Methods and Models in Automation and Robotics (MMAR), Poland, Międzyzdroje, 2-5 September 2014, pp. 726-731, ISBN 978-1-4799-5082-9

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, tasks preparation) [1]	60	2,0

[1] delete or add other activities as appropriate