COURSE DESCRIPTION CARD - SYLLABUS

Course name
Microcontrollers in practice [N2Inf1-AMiWdIP>MIKRO]

Course

Field of study
Computing

Year/Semester
2/3

Area of study (specialization)
Mobile and Embedded Applications for the Internet of Things

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
16

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

A student starting the Microcontrollers in Practice course should have basic knowledge of physics and digital and analog technology. He should have the ability to solve basic problems in the field of electrical engineering and electronics, programming in C and Python, creating application and the ability to obtain information from indicated sources. He should also be ready to cooperate within a team. Moreover, in terms of social competences, the student must demonstrate such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

1. Providing students with knowledge of microcomputer systems in the field of: microcontroller architecture, configuration of microcontroller functional systems, digital interfaces, diagnostics and their use in various areas of life. 2. Providing students with additional knowledge of digital and analog technology, in the field of sensors and other selected systems cooperating with microcontrollers. 3. Developing students' problem-solving skills regarding the principles of connecting electronic systems, operating sensor systems and selected microcontroller environment systems, commissioning and diagnostics of electronic systems and simple embedded systems, creating software for simple tasks for systems with microcontrollers. 4. Developing students' teamwork skills in the implementation of simple projects during laboratory classes.

Course-related learning outcomes

Knowledge:
1. has ordered, theoretically founded general knowledge in the field of microcontrollers - [K2st_W2]
2. has advanced detailed knowledge of the architecture of microcontrollers, operation of internal devices of microcontrollers and their configuration - [K2st_W3]
3. has knowledge about trends and the most important new achievements in the development of microelectronics, nanotechnology, in particular IoT, microcontrollers, sensors, embedded systems, - [K2st_W4]
4. knows the basic methods, techniques and tools used to solve complex engineering tasks in the field of microcontrollers at the stage of designing, building systems and programming - [K2st_W6]

Skills:
1. can use literature information, databases and other sources in Polish and in a foreign language; - [K2st_U1]
2. can plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and draw conclusions as well as formulate and verify hypotheses related to complex engineering problems and simple research problems related to the use of microcontrollers - [K2st_U3]
3. can use to formulate and solve engineering tasks and simple research problems related to microcontrollers, analytical, simulation and experimental methods - [K2st_U4]
4. can - when formulating and solving engineering tasks related to the use and programming of microcontrollers - integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a system approach, also taking into account non-technical aspects - [K2st_U5]
5. can assess the usefulness and the possibility of using new achievements (methods and tools) and new IT products in the design and programming of systems with microcontrollers - [K2st_U6]
6. can solve tasks containing a research component in the design and programming of systems with microcontrollers - [K2st_U10]
7. can determine the directions of further learning and implement the self-education process, including other people in the field of microcontrollers - [K2st_U16]

Social competences:
1. understands that in computer science, knowledge and skills very quickly become obsolete, this also applies to specific systems such as microcontrollers.- [K2st_K1]
2. understands the importance of using the latest knowledge in the field of computer science in solving research and practical problems in the field of microcontrollers, - [K2st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative evaluation:
a) in terms of lectures:
- based on answers to questions about the material covered in previous lectures,
b) in the scope of laboratories:
- based on the current assessment of the implementation of laboratory tasks.
- assessment of the student's preparation for individual laboratory sessions and assessment of skills related to the implementation of laboratory exercises;

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

- assessment of knowledge and skills demonstrated during a problem-based colloquium, consisting of 5 descriptive tasks selected from the list of issues previously made available to students (approximately 20-25 issues);
-discussion of the results and, in doubtful individual cases, additional control questions,
- passing the test with more than 50% of the maximum number of points - according to the scale: 50-60% grade: dst (3.0), 61-70% grade: dst plus (3.5), 71-80% grade: good (4, 0), 81-90% rating: good plus (4.5), 91-100% rating: very good (5.0)

b) in the field of laboratories, verification of the assumed learning outcomes is carried out by:
- continuous assessment in every class;
- rewarding the increase in skills in using the learned principles and methods;
- evaluation of reports prepared on selected issues carried out within the laboratory; this assessment also includes the ability to work in a team - the final grade is the average of the current grades from the reports,

Obtaining additional points for activity during classes, especially for:
- discussion of additional aspects of the issue;
- effectiveness of applying the acquired knowledge when solving a given problem;
- ability to cooperate as part of a team practically implementing a detailed task in the laboratory;
- comments related to the improvement of teaching materials;
- identifying students' perceptual difficulties enabling ongoing improvement of the teaching process.

Programme content

The course program includes providing knowledge and practical skills in the construction and use of the most popular microcontrollers on the market in solutions based on the concept of the Internet of Things. Content related to microcontroller architecture, I/O devices, methods of communication with external devices and their application in indicated fields are also discussed.

Course topics

The lecture program covers the following topics:
- introduction to microcontrollers, architecture,
- microcontroller families,
- input and output devices - types and construction,
- selected communication interfaces (RS232, I2C, SPI, 1-WIRE),
- the use of microcontrollers in indicated fields of technology and science.

Laboratory classes are held in blocks, each with 2 units. The laboratory program covers the following topics:
- introduction to operating and running applications on the platforms indicated by the teacher - Raspberry Pi Pico (RP2040) and the MicroPython language.
- control of general-purpose ports, operation and use of basic actuating and measuring elements such as: temperature sensors, LCD and OLED displays, servomechanisms, etc.,
- handling interrupts, clock systems, A/D and D/A converters, threads.
- introduction to network communication, e.g. BT, Wi-Fi,
- using network sockets to run simple web servers.

It is assumed that it will be possible to complete a simple project as a summary of the discussed issue.

Teaching methods

1. lecture: multimedia presentation illustrated with examples given on the board,
2. laboratory classes: practical hardware and software implementation of selected topics from the lectures, consultations on the exercises.

Bibliography

Basic:
1. Wprowadzenie do Raspberry Pi, Richardson M., Wallace S., Donat W., Warszawa, APN Promise, 2022.
2. Mikrokontrolery dla hobbystów : projekty DIY w języku C i C++, Garcia-Ruiz M.A, Mancilla P.C, Helion, Warszawa, 2022.
3. Projektowanie systemów mikroprocesorowych, Hadam P., BTC, Warszawa, 2004

4. Embedded Systems: Introduction to ARM- Cortex-M-Microcontrollers - Volume 1, Valvano J.W., Jonathan W. Valvano 2013; ISBN: 978-1477508992
Additional
1. Microcontrollers in practice, Mitescu M., Susnea I. , Springer , Berlin, 2005
2. Embedded microcontroller interfacing, Gupta G.S., Mukhopadhyay S.C., Springer 2010
3. Embedded programming, Chew M.T., Gupta G.S., Silicon laboratories, 2005
4. Designing embedded systems and Internet of Things (IoT), Xiao P., Wiley, 2018
5. Internet sources, eg. www.silabs.com, www.atmel.com, www.ti.com, www.st.com

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	32	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	43	1,50