COURSE DESCRIPTION CARD - SYLLABUS

Course name
Microcontrollers in practice

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 studies

Course offered in
polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
16	16	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr inż. Zygmunt Kubiak

Responsible for the course/lecturer:

Prerequisites

A student starting this course should have basic knowledge of physics, electronics, digital and analog techniques.

He should have the ability to solve basic problems in the field of electrical engineering and electronics, programming in C, creating application operation algorithms and the ability to obtain information from the indicated sources.

He should also be ready to cooperate as part of the team. In addition, in terms of social competences, the student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1.To provide students with basic knowledge of microcontrollers, in the field of microcontroller architecture, configuration of microcontroller functional devices, digital interfaces, diagnostics.

2. Providing students with complementary knowledge of digital and analog technology in the field of sensors and other selected systems cooperating with microcontrollers.

3. Developing skills related to the principles of connecting electronic circuits, handling sensors and selected microcontroller environment systems, starting and diagnosing electronic circuits and simple embedded systems, creating software for systems with microcontrollers.

4. Shaping students' teamwork skills as part of the tasks carried out in the laboratory.

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:

Initial assessment:

a) in the field of lectures: - on the basis of answers to questions about the material discussed in previous lectures,

b) in the field of laboratories: - based on the assessment of the current progress in the implementation of tasks,

Summative assessment:

a) in the field of lectures, verification of the assumed learning outcomes is carried out by: - assessment of the knowledge and skills demonstrated in a problem-based test, consisting of problem tasks selected from the list of issues previously made available to students (5 questions from 20 problem issues); - discussion of the results and, in individual cases, additional control questions,

b) in the field of laboratories, verification of the assumed learning outcomes is carried out by: - assessment of skills related to the implementation of laboratory exercises;- continuous assessment, during each class - rewarding the increase in the ability to use the learned rules and methods; - evaluation of reports prepared on selected issues carried out in the laboratory; this assessment also includes teamwork.

Programme content

The lecture program covers the following topics: IIntroduction to microcontrollers. Generations of microcontrollers. Architecture of microcontrollers. Selected families of microcontrollers. Startup modules. Microcontroller peripherals. I / O ports, organization, rules for connecting with external systems, port programming. Timers, organization, implementation of counter and time functions, generators. AC and CA converters. Interrupt system, organization, handling of external events, handling of microcontroller functional systems, handling of synchronous time events, implementation of virtual timers. Microcontroller interfaces. Synchronous and asynchronous interfaces. Selected interfaces: RS 232, IIC, SPI, 1-Wire. JTAG diagnostic bus, purpose, organization, rules of use and maintenance. Designing systems based on microcontrollers. Principles of connecting electronic circuits (analog and digital). Sensors, selected solutions, operation, interfaces, rules of use, program service. Programming of microcontrollers in C language. Different approaches of microcontroller manufacturers to programming. Synchronous algorithms. Configuration of the functional systems of the microcontroller.

Laboratory classes are conducted in the form of seven 2-hour exercises in the laboratory, preceded by a 2-hour instructional session at the beginning of the semester. Classes are carried out in teams of 2 students. The laboratory program covers the following topics: Introduction to running applications on selected development modules with 8-bit, 16-bit or 32-bit microcontrollers, e.g. Silicon Labs, Toolstick UNI DC type, with C8051F020 microcontrollers (8-bit), Texas Instruments, MSP430 Launchpad (16-bit)) or Texas Instruments Tiva Launchpad (32-bit). Configuration of the microcontroller. Implementation in C language of simple programs such as LED control with a simple time loop; using a timer; without interrupts and with interrupt handling. Button operation. Programs that use AC and CA processing. Terminal service. Measurement of voltage, temperature using a sensor with an analog output. It is assumed that a simple design can be made.

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board,

2. Laboratory exercises: presentation of the issues of exercises, implementation of the issues presented in the laboratory exercise program,

Bibliography

Basic

1. Projektowanie systemów mikroprocesorowych, Hadam P., BTC, Warszawa, 2004

2. Mikrokontrolery STM32 w praktyce, Paprocki K., BTC, Warszawa, 2009

3. Programowanie mikrokontrolerów 8051 w języku C w praktyce, Bogusz J., BTC, Warszawa, 2005

4. Embedded Systems: Introduction to ARM- Cortex-M-Microcontrollers - Volume 1, Valvano J.W., Jonathan W. Valvano 2013; ISBN: 978-1477508992

5. Embedded Systems: Real-Time Interfacing to ARM- Cortex-M -Microcontrollers - Volume 2, Valvano J.W., Jonathan W. Valvano 2013; ISBN: 978-1463590154

6. Presentations for lectures

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	109	4
Classes requiring direct contact with the teacher	38	2
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests, project preparation) [1]	50	2

[1] delete or add other activities as appropriate