COURSE DESCRIPTION CARD - SYLLABUS

Course name
Embedded systems interfaces [N2Inf1-AMiWdIP>ISW]

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

dr inż. Zygmunt Kubiak

Lecturers

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 in the field of selected protocols of wired and wireless transmission, with particular emphasis on the interfaces of microcontrollers, sensors and actuators. 2. Providing students with complementary knowledge in the field of protocol organization, technical implementation of transmission, hardware and software solutions for network modules (nodes), transmission security, applications.

Course-related learning outcomes

Knowledge:

1. has an ordered, theoretically founded general knowledge in the field of selected branches of electronics - [K2st_W2]
2. has ordered, theoretically founded general knowledge in the field of microcontroller architecture as well as wired and wireless sensor networks - [K2st_W3]
3. has knowledge of development trends and the most important new achievements in the development of microelectronics, nanotechnology, in particular microcontrollers, sensors, embedded systems and interfaces used- [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 - [K2st_U3]
3. can use to formulate and solve engineering tasks and simple research problems concerning interfaces of embedded systems, analytical, simulation and experimental methods - [K2st_U4]
4. can - when formulating and solving engineering tasks concerning interfaces of embedded systems and microcontrollers - integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a systemic approach, taking into account also non-technical aspects - [K2st_U5]
5. Can evaluate 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 and their interfaces - [K2st_U6]
6. can solve tasks containing a research component in the design and programming of systems with microcontrollers and embedded systems interfaces - [K2st_U10]
7. can determine the directions of further learning and implement the self-education process, including other people in the field of microcontrollers and embedded systems interfaces- [K2st_U16]

Social competences:
1. understands that in computer science, knowledge and skills very quickly become obsolete.- [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 embedded systems interfaces, - [K2st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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

Introduction to digital protocols and interfaces. The issues are related to the interfaces supported by the hardware of the microcontroller and other interfaces that are used in embedded systems. Transmission security in wired and wireless networks. Methods of ensuring the integrity of transmitted data

(redundant coding, CRC). Wired network protocols. Selected field networks (Fieldbus), eg Modbus, Hart, MBus, CAN, LIN, Ethernet. Selected low-power wireless networks, including LPWAN, eg ZigBee, SimpliciTI, LoRA, Sigfox. The issue of energy efficiency. Serial transmission interfaces embedded in microcontrollers and used for short distance communication (between integrated circuits and modules). Protocols and system solutions of serial transmission standards: UART (RS232, RS422, RS485), USB, IIC, SMBus, SPI, Microware, 1-Wire). Non-standard interfaces of selected sensors and actuators.
Introduction to selected microcontrollers (if necessary). Programming of serial transmission interfaces in C language for selected microcontrollers. Software frame integrity assurance - redundant coding, CRC8, CRC16, CRC32. Examples and rules of program service for systems equipped with serial buses (sensors, LCD displays, AC / CA converters, memories, etc.). Product life time.
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 by 2-person teams of students. The laboratory program covers the following topics:
Introduction to running applications on modules of selected development modules with microcontrollers, e.g. from Atmel, type ATmega32 (Arduino module), Silicon Labs, Toolstick UNI DC type with C8051F020 microcontrollers, or Texas Instruments, type MSP430, Tiva Launchpad, or Nucleo type STM. Configuration of the microcontroller. Implementation of simple C language programs (if necessary) such as LED diodes control, button operation. Programs that use AC and CA processing. Implementation of UART, IIC, SPI transmission as well as non-standard interfaces of selected sensors. Programming microcontrollers for real-time systems according to the rules presented in the lectures for various classes of microcontrollers (8-, 16-, 32-bit) and various programming tools.

Course topics

none

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	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