COURSE DESCRIPTION CARD - SYLLABUS

Course name
Microcontrollers and SoC (System-on-Chip) in Teleinformatics Systems [S2Teleinf2-SDP>MIKRO]

Course

Field of study
Teleinformatics

Year/Semester
2/3

Area of study (specialization)
Software-defined systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
14

Laboratory classes
24

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Sławomir Michalak
slawomir.michalak@put.poznan.pl

Lecturers

Prerequisites

A student entering this subject should have a basic knowledge of digital and analogue electronic circuits, microprocessor technology and data communication signals and systems.He or she should be able to use concepts and make proper use of basic applications of analogue, digital circuits and microprocessors, obtain information from indicated sources and perform calculations in mathematical analysis and signal theory. In addition, the student should understand the necessity of extending his/her competences and present such attitudes as honesty, responsibility, perseverance, commitment, cognitive curiosity, personal culture and respect for other people.

Course objective

1. to provide students with knowledge of the application of microcontrollers and SOCs in data communication systems. 2. to teach students the ability to analyse, design, program and apply microcontrollers in data communication systems using standard interfaces for wired and wireless data transmission. 3. to understand the importance of the problem of reliability of transmitted data, to perceive and take into account changes resulting from technological progress, to continuously improve professional competences and to develop a sense of responsibility for projects under development.

Course-related learning outcomes

Knowledge:
1 The student has a structured knowledge of the application of microcontrollers and programmable circuits in data communication systems. (K2_W04, K2_W07)
2. masters the principles of operation of data communication systems using microcontrollers and programmable circuits and knows the standard interfaces used to transmit commands and data. (K2_W02)
3. has a basic knowledge of the architecture, operating modes and programming of embedded resources in microcontrollers and SoCs. (K2_W05)

Skills:
1. the student is able to use source data, integrate new information, analyse and interpret it critically, as well as formulate and justify opinions. (K2_U01, K2_U02, K2_U03)
2. is able to analyse variants of a data transmission system in terms of the choice of data transmission method, division of tasks between hardware and software, complexity of a solution and costs. (K2_U04, K2_U07, K2_U11)
3. is able to program microprocessor interface modules using low and high level languages. (K2_U09, K2_U10)

Social competences:
1. the student recognises changes resulting from technological progress and understands the necessity of updating knowledge and continuously improving professional competences. (K2_K01)
2. understands the significance of the problem of reliability of measurement data, transmitted in order to assess measurement results and to make decisions on this basis. (K2_K06)
3. is aware of the responsibility for his/her own work and is able to follow the rules of teamwork. (K2_K02)
4. is able to inspire and creatively contribute to project works, which require knowledge in the field of data transmission in ICT systems. (K2_K04, K2_K05)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written and/or oral final assessment verifies knowledge and understanding of the lecture content. It includes open problem questions with differentiated scoring. Final evaluation from the lecture credit: below 50% of the number of points possible - 2.0; from 50% - 3.0; from 60% - 3.5; from 70% - 4.0; from 80% - 4.5; from 90% - 5.0.
The final laboratory grade is the arithmetic average of the weighted grades for the core and additional tasks (including preparation for subsequent tasks, behaviour, commitment, consolidation of skills) and the grades for the individual or team reports concluding the tasks. The weighting and grading scale is determined in the introductory class. Additional assignments verify skills when applying for lab credit or a grade increase. They may include a written or oral colloquium. For final grades, a scale may be introduced: up to and including 2.75 - 2.0; above 2.75 - 3.0; above 3.25 - 3.5; above 3.75 - 4.0; above 4.25 - 4.5; above 4.75 - 5.0. Corrective laboratory credit includes a practical part and a written or oral colloquium.

Programme content

The course program covers the following topics:
• Microcontrollers and SoCs.
• Tasks of resources embedded in the IT system.
• Architecture of I/O modules in 8- and 32-bit systems.
• Hardware and software implementation of transmission protocols in communications wired and wireless.
• Distributed systems with a radio link.
• Microcontrollers and SoC systems in mobile systems.
• Communication of the microprocessor subsystem and SoC modules with a PC and computer network.

Course topics

The lecture program covers the following topics:
• The importance of microcontrollers and SoCs in the context of resource integration in ICT systems. Tasks of embedded resources in an ICT system.
• Microcontrollers and SoCs as central units of an ICT system and ICT network nodes. System

requirements for embedded memories and caches.
• Architecture of I/O modules in 8-bit and 32-bit systems. Configuration and initialisation of modules for data transmission.
• Hardware and software implementation of transmission protocols in wired communications. Integration of system resources in SoCs and reprogrammable circuits. Interaction of microcontrollers and SoCs with radio modules.
• Radio module architecture and wireless links in the ISM band. Distributed systems with radio link. Operating conditions of microcontrollers and SoCs in mobile systems.
• Microcontrollers and SoCs in reduced power modes. Communication of microprocessor subsystem and SoC modules with PC and computer network.
Laboratory:
• Development environment as an essential support for the commissioning process of ICT system hardware resources integrated in microcontrollers and SoCs. Initialisation of resources using simulation tools - programming in low and high level languages.
• Hardware and software implementation of data communication (USART, I2C, SPI, 1-wire) using supporting tools.
• Configuration and commissioning of the interface in the target system using didactic evaluation modules. Software and hardware modification of transmission parameters. Configuration and commissioning of master - slave connections, implementation of slave circuit search algorithm, arbitration, configurations with multiple masters.
• Commissioning of embedded resources and radio modules in systems with wireless connectivity. Single channel and multi-channel transmission tests. Addressing of devices and subsystems, data exchange between lab groups, increasing transmission range.
• Analysis of transmission protocol and observation of timing parameters, diagnostics using dedicated measuring instruments (digital oscilloscope, logic state analyser, spectrum analyser).

Teaching methods

Lecture: lecture with multimedia presentation, supported by problem discussion and examples on the blackboard.
Laboratory: performance of problem tasks given by the instructor, preceded by an introduction, using the blackboard, programming environment and audio-visual tools, and verification of results using the programming environment and running sets, incorporating methods of team cooperation. The problem task given by the instructor may be carried out over several laboratory classes (units).

Bibliography

Basic:
1. Marcin Peczarski: Mikrokontrolery STM32 w sieci Ethernet w przykładach, BTC, Warszawa, 2011
2. Waldemar Nawrocki: Rozproszone systemy pomiarowe, WKiŁ, Warszawa 2006
3. Jacek Bogusz: Lokalne interfejsy szeregowe w systemach cyfrowych, Wyd. BTC, Warszawa 2004

Additional:
1. Krzysztof Wesołowski: Systemy radiokomunikacji ruchomej, WKiŁ, 2006
2. Maciej Szumski: Mikrokontrolery STM32 w systemach sterowania i regulacji, BTC, 2017

Breakdown of average student's workload

	Hours	ECTS
Total workload	103	4,00
Classes requiring direct contact with the teacher	38	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50