COURSE DESCRIPTION CARD - SYLLABUS

Course name
Data transmission protocols

Course

Field of study
Computing Science

Year/Semester
1/1

Area of study (specialization)
Computing Microsystems

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	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: Student starting this module should have a basic knowledge in the field of embedded systems, sensors and computer hardware.

Skills: The student should be able to obtain information from the indicated sources, as well as understand the need to expand his competences and be ready to cooperate in a team.

Social Competences: The student should show such features as: honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. To provide students with knowledge on the construction and operation of digital interfaces used in modern computing system and IoT.

2. Present students a set of development technologies for modeling and implementing inter integrated circuit interfaces and inter boards transmission.

3. Developing students' skills in solving technical problems in the field of transmission interfaces design.

4. Shaping teamwork skills in students - the ability to cooperate in the design teams and in the preparation of technical reports.

Course-related learning outcomes

Knowledge

1. has detailed knowledge related to selected areas of computer science, data transmission protocols and interfaces,
2. has knowledge about new technologies in the area of computer engineering and embedded systems,
3. has detailed knowledge about serial data transmission and fast interfaces in field programmable embedded systems
4. knows the basic methods, techniques and tools used to solve complex engineering tasks in the field of analysis of communication protocols,
5. has knowledge about the application and limitations of various communication standards.

Skills

1. is able to select the standard of inter-system communication appropriate for the task being performed and plan the way of addressing and exchanging data,
2. is able to prepare communication software for a multi-module embedded system, test the correctness of its operation, detect and remove existing errors,
3. is able to design and develop a hardware layer of complex digital transmission system,
4. is able to design (according to a provided specification which includes also non-technical aspects) a digital system using technologies learned during the course,

Social competences

1. understands that knowledge and skills related to computer science quickly become obsolete,
2. is able to comprehensively and responsibly compose a report on a completed task,
3. Is able to work in a team of designers, carrying out a part of the design task, taking into account the constraints

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) lectures: based on the answers to the questions which test understanding of material presented on the lectures

b) laboratory classes: based on the assessment of the tasks done during classes and as a homework

Summative assessment:

a) verification of assumed learning objectives related to lectures within an online written test. The final grade is determined using the following scale: (90%, 100%] -> 5.0, (80%, 90%] -> 4.5, (70%, 80%] -> 4.0,

(60%, 70%] -> 3.5, (50%, 60%] -> 3.0, (0%, 50%] -> 2.0.
b) verification of assumed learning objectives related to laboratories is based on verification of the laboratory tasks. The final grade is determined using the following scale: (90%, 100%] -> 5.0, (80%, 90%] -> 4.5, (70%, 80%] -> 4.0, (60%, 70%] -> 3.5, (50%, 60%] -> 3.0, (0%, 50%]-> 2.0.

Getting extra points for activity during classes, especially for:
- proposing to discuss additional aspects of the issue,
- effectiveness of applying the acquired knowledge while solving a given problem,
- ability to work within a team that practically performs a specific task in a laboratory.

Programme content

The lecture program includes the following topics:
Basic concepts in signal transmission (serial and parallel, synchronous and asynchronous transmission, conversion methods (SERDES); bit rate, bandwidth, transmission methods, line coding methods; OSI model, network topologies, transmission protocols; error detection and correction methods; differential signaling and single-ended signals).

Low and medium speed serial interfaces:
-- I2C bus - Inter-Integrated Circuit (structure of connections making up the I2C bus; basic transmission format; transmission acknowledgment and interruption mechanisms; procedure for changing the transmission direction; rules for addressing the I2C bus nodes; mechanism for detection and resolution of collisions - arbitration; software support for transmission on the I2C bus ; examples of systems with I2C interface),
-- SPI synchronous interface - Serial Peripheral Interface (Single-Master system structure and its extension to Multi-Master; typical structures of SPI bus transmission interfaces; method of connecting Master and Slave systems in 3 and 4-wire configuration; transmission formats - polarization and phase; methods configure the polarization and phase of the transmission clock; build the SPI bridge),
-- SCI asynchronous interface - Serial Communication Interface (set of RS-232C interface signals; transmission word format; phasing process of the receiver's asynchronous clock; limit values of the receiver clock deviation; connection of circuits via the SCI interface),
-- 1-Wire bus (sensor networks based on 1-Wire bus; basic transaction format; node identifier - Lasered ROM; 1-Wire bus transmission word format; reading time slot),
-- CAN bus - Controller Area Network (concept of a message-oriented system, the structure of connections making up the CAN bus; transmission code; bitstuffing; types of transmission frames; message filtering technique; collision detection and resolution mechanism).

High-speed serial interfaces (Ethernet; LVDS; HyperTransport; DisplayPort; HDMI; MIPI; SATA; PCI Express).

Network protocols and their hardware layer (IP, UDP, TCP protocol format; MII, RMII, GMII, RGMII, SGMII interfaces; fast gigabit transceivers in programmable structures).

Debugging and programming interfaces in reprogrammable systems (JTAG, SelectMap, ICAP, BPI, SPI). Protocol analyzers, measurement and debugging methods.

Laboratory classes are conducted in the form of 2-hour lab exercises, preceded by a 2-hour instructional session at the beginning of the semester. Exercises are carried out by 2-person teams.
The program of laboratory classes includes the following topics:
- modeling the hardware layer of serial interfaces, defining test cases for devices with I2C, SPI interfaces;
- UDP datalogger operation test with MII and RMII interface,
- defining own data transmission protocol,
- using LabView software to capture and process network data;
- design and implementation of a serial data transmission analyzer for the selected protocol (using the FPGA platform);
- use of software analyzers to capture and analyze traffic in the Ethernet network.

Some of the above-mentioned program content is carried out as part of the student's own work

Teaching methods

1. Lecture with multimedia presentation (diagrams, formulas, definitions, etc.) supplemented by the content of the board.
2. Laboratory exercises: multimedia presentation, presentation illustrated with examples given on the board and performance of tasks given by the teacher - practical exercises.

Bibliography

Basic

1. Bogusz J., Lokalne interfejsy szeregowe w systemach cyfrowych, BTC, Warszawa 2004, ISBN: 83-921073-0-6.
2. Douglas E. Comer , Sieci komputerowe i intersieci : aplikacje internetowe, Warszawa : Wydawnictwa Naukowo-Techniczne, 2007, ISBN: 978-83-204-3270-1.

Additional

1. Michael Gook, Interfejsy sprzętowe komputerów PC, Gliwice: Helion 2005, ISBN: 83-7361-663-2.
2. Lambert M. Surhone, Mariam T. Tennoe, Susan F. Henssonow, Reduced Gigabit Media Independent Interface, Betascript Publishing 2010, ISBN: 978-613-2-47179-6.
3. IEEE Std 802.3U, 1995, IEEE Standards for Local and Metropolitan Area Networks: Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4
Classes requiring direct contact with the teacher	50	2
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, techical reports preparation) [1]	50	2

[1] delete or add other activities as appropriate