COURSE DESCRIPTION CARD - SYLLABUS

Course name

Urządzenia w systemach teleinformatycznych - Devices in ICT Systems

Course

Field of study
Teleinformatics

Year/Semester
2/4

Area of study (specialization)

Profile of study
general academic

Level of study
first-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other (e.g. online)

Tutorials
0

Projects/seminars
30/0

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

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Institute of Communication and Computer Networks
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tel.: 61 665 3926, room: P-207

Responsible for the course/lecturer:

Prerequisites

Students taking this course should have basic knowledge of computer networks and network protocols and basic knowledge of telecommunication networks. Students should use C/C++ programming languages. Students should be able to acquire information from literature and standards as well as other sources in Polish or English and should be able to integrate obtained information, make interpretations, draw conclusions and justify opinions. Students can carry out team projects.

Course objective

The aim of the course is to familiarize students with the functioning of computer network devices, realization of functions in different layers of TCP/IP and OSI RM model. Within the scope of the course students will learn about router construction (in the scope of data switching, packet forwarding information search, queuing), layer two switch, ADSL devices, EPON, GPON, XGPON, NG2-PON2, 25G-PON and 50G-PON. Learn about access network standards. Learning about network processors and FPGAs. SDN networks and P4 programming principles will also be discussed.

Course-related learning outcomes

Knowledge

1. Students know the principles of computer program construction, has knowledge of computer science and knows the syntax of software languages P4 . Knows the principles of constructing programs that control the operation of network processors and SDN devices.
2. Students have a structured knowledge of network processor architecture. Has a structured knowledge of the architecture of network devices such as routers and switches. 3.
3. Students havebasic knowledge in fundamentals of structure, standards, architecture, network protocols and operation of wide area and local area networks, in particular network devices

Skills

1. Students are able to configure network devices that perform simple network functions, and be able to start a local area network. Be able to implement simple network functions in SDN devices. Be able to program a network processor that performs layer 2-4 functions. 2.
2.Students are able to select the design of network devices according to technical requirements and operating conditions.

Social competences

1. Student understand the importance of information society for national development.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge gained in the lecture is verified by an exam in written or oral form. In the written form, students must provide answers to 50-90 questions (test and open) differently scored. There are three or four point groups. However, in the oral examination, the student draws one question from each scoring group. In an oral format, for each question drawn, the student may be asked an additional question (related to the question drawn). The evaluation of the question (includes the answer to both

the drawn question and the supplementary question) includes the breadth of the answer and the depth of understanding of the question. There are 50-60 questions prepared for each exam. Successful completion of the examination requires a minimum score of 50%.
The skills acquired as part of the projects will be assessed on the basis of partial marks received from the projects. The pass mark is 50%.

Examination and passing grade criteria:

number of points	grade
<50 %	2,0
50% - 60%	3,0
61% - 70%	3,5
71% - 80%	4,0
81% - 90%	4,5
91% - 100%	5,0

Programme content

Issues discussed during the lectures:
1. Classification of ICT network devices. Areas of application: LAN, MAN, WAN, WLAN, PAN. Backbone networks, access networks. Media and transmission techniques. Classification of network protocols.

2. Layer I and II network node devices: Layer II functions and structure. Regenerators: functions, types, key features. Bridges: functions, types, key features. Switches: modes of operation, basic architectures, structure.

3. Network node devices - layer III: Routers. Basic functions. Routers classification. RIB and FIB tables. Basic architectures. Design. Criteria of router selection.

4. Access networks: xDSL technology, architecture of access networks. IDSL, ADSLx, HDSL, VDSL techniques: functions, data transmission capabilities, operating parameters. Problems of using the existing infrastructure. PON network structure. Limitations of use. Networks based on IEEE and ITU-T standards. OLT and ONU design. Flow control mechanisms, MPCP protocol.

5. SAN: Storage Area Networks (SAN) concept. SAN topologies and products. Problem of isolation in SANs. SAN management. I/O techniques. Resource virtualization.

6. FPGA devices and network processors: Classification and purpose of programmable devices. Programming languages. NetFPGA architecture. Network processor architecture. Example applications.

7. Interfaces of peripheral devices: RS232, RS423A, RS422A, RS485, RS366A, RS530, X20, X21, V.35, HSSI, HIPPI interfaces. Null modem. USB interface: connectors and cabling, coding, communication model, method of data transfer, bus management, transactions, data format, error detection and transmission control, descriptors, power supply, device classes. FireWire: how to access the bus, error detection and correction, synchronization, performance. Transmission Media. PAN networks

8.Industrial Ethernet: Discussion of Modbus, HART, ProfiBus, Fieldbus protocols. Overview of CAN, LIN, Flexray, Safe-by-Wire, I2C, D2B, MOST buses. Industrial Ethernet: physical layer, data link layer, higher layers including application layer, interfaces, performance.

9. Power supply for network devices: Types of power sources. Requirements for power supply systems. Types of overvoltage and overload protection. UPS power supplies. POE systems - principle of operation and area of application. Methods of reducing electrical energy consumption.

10. P4 programming: P4 language basics, Portable Switch Architecture (PSA) and Portable NIC Architecture (PNA), runtime environment, implementation of simple network functions.

Project.
Projects carried out by students are in line with the content covered in lectures

Content for the next academic year:
1. CPU, GPU, TensorFlow, FPGA, SoC programming - oneAPI and SYCL environment.

Teaching methods

1. Lecture: multimedia presentations illustrated with examples given on the blackboard.
2. Project: presentations prepared by students, projects in P4 language of simple functionalities of network devices

Bibliography

Basic

1. W. Kabaciński, M. Żal: Sieci Telekomunikacyjne, WKiŁ, 2008.
2. Wesołowski K., Systemy radiokomunikacji ruchomej, WKiŁ, 2006

Additional

3. Ran Giladi , Network processors: architecture, programming, and implementation. Morgan Kaufmann (Elsevier). ISBN 978- 0-12-370891-5.

Breakdown of average student's workload

	Hours	ECTS
Total workload	116	4.0
Classes requiring direct contact with the teacher	60	2.0
Student's own work (preparation for tests, project preparation, literature studies)	56	2.0