



COMPUTER NETWORKS

(Syllabus)

Реквізити навчальної дисципліни

| | |
|--|---|
| Level of higher education | First (undergraduate) |
| Branch of knowledge | 12 Information technologies |
| Specialty | 123 Computer engineering |
| Educational program | Computer systems and networks |
| Discipline status | Normative |
| Form of education | full-time (full-time) part-time |
| Year of training, semester | 3rd year, spring semester |
| Scope of the discipline | 5 credits/ 150 hours. |
| Semester control/ control measures | Examination |
| Timetable | According to the schedule for the spring semester of the current academic year at http://rozklad.kpi.ua/ |
| Language of teaching | English |
| Information about head of the course / teachers | Lecturer: prof. of Computer Engineering, Doctor of Technical Sciences, Yu.O. Kulakov, ya.kulakov@gmail.com |
| Placement | //comsys.kpi.ua |
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Program

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

The purpose of teaching the discipline is to acquire the knowledge, skills and abilities necessary for a specialist who specializes in the design and operation of computer networks.

- The tasks of studying the academic discipline are:

- Ability to learn and master modern knowledge (ZK2)

- Ability to create system and application software for computer systems and networks (FC3)

- Ability to use design automation tools and systems to develop components of computer systems and networks, Internet applications, cyber-physical systems, etc. (FC5).

- Ability to design, implement and maintain computer systems and networks of various types and purposes. (FC6)

- Ability to use and implement new technologies, including technologies of smart, mobile, green and secure computing, to participate in the modernization and reconstruction of computer systems and networks, various embedded and distributed applications, in particular with the aim of increasing their efficiency (FC7)

- Willingness to participate in works on the implementation of computer systems and networks, putting them into operation at objects of various purposes. (FC8)

- Ability to systemically administer, use, adapt and operate existing information technologies and systems (FC9)

- Ability to design, implement and maintain high-performance parallel and distributed computer systems and their components using FPGA modules and automated design systems (FC16)

- Ability to design, implement, administer and maintain global, local intelligent software-configured computer networks (FC17)

Program Learning Outcomes (PLP)

- To know and understand the scientific principles underlying the functioning of computer tools, systems and networks (PRN1).

- Know the latest technologies in the field of computer engineering. (PRN3)

- Know and understand the impact of technical solutions in the public, economic, social and environmental context (PRN3).

- To be able to solve problems of analysis and synthesis of means characteristic of the specialty (PRN7)

- To be able to apply knowledge of technical characteristics, design features, purpose and rules of operation of software and technical means of computer systems and networks to solve technical problems of the specialty (PRN9)

- Be able to develop software for embedded and distributed applications, mobile and hybrid systems, calculate, operate, equipment typical for the specialty (PRN10)

- To be able to search for information in various sources to solve computer engineering problems (PRN11).

-To be able to identify, classify and describe the operation of computer systems and their components (PRN13).

- To be able to perform experimental research on a professional topic (PRN15)

- Perform parameter calculations of individual blocks of computers, computer systems, computer networks (PRN22)

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

Necessary disciplines: "Programming", "Object-oriented programming", "System programming", "Data structures and algorithms", "Software engineering", "Algorithms and calculation methods"

Disciplines based on the learning outcomes of this discipline: "Organization of computing processes", "Computer systems", "System software", "Technology of distributed computing"

3. Content of the academic discipline

Chapter 1. Network technologies.

Topic 1.1. The aim and task of the course. Evolution of computer networks.

Topic 1.2. Basics of building computer networks.

Topic 1.4. Reference model of interaction of open systems.

Topic 1.5. Physical environment of transmission of discrete signals.

Topic 1.6. Error protection.

Chapter 2. Architecture of local networks

Topic 2.1. Basic standards of local computer networks

Topic 2.2. Management of the logical channel of local networks

Topic 2.3. Access of subscriber systems to the common transmission environment

Chapter 3. Ethernet network (Standard 802.3)

Topic 3.1. 10BASE-5 Ethernet network

Topic 3.2. 10BASE-2 Ethernet network

Topic 3. 3. 10BASE-T Ethernet network

Topic 3. 4. Fast Ethernet and Gigabit Ethernet networks

Chapter 4. Mobile computer networks.

Topic 4.1. Architecture of wireless networks.

Topic 4.2. Wireless environment of information transmission

Topic 4.3. Satellite communication

Topic 4.4. Mobile computer networks (IEEE 802.11. standard)

Topic 4.5. Management of access to the transmission medium

Chapter 5. ATM network.

Topic 5. 1. Basic principles of ATM technology.

Topic 5.2. The concept of a virtual communication channel.

Topic 5.3. Traffic classification.

Topic 5.4. Service quality parameters.

Topic 5.5. ATM protocol stack.

Topic 5.6. Adaptation level ALL.

Topic 5.7. Categories of ATM protocol services and traffic management.

Chapter 6. Transport level in Internet networks.

Topic 6.1. Transport service of computer networks.

Topic 6.2. TCP/IP protocol stack. IP address formats.

Topic 6.3. Functions of the network layer.

Topic 6.4. Route information exchange protocols.

Topic 6.5. Traffic classification. Traffic distribution algorithms.

Topic 6.6. Traffic management.

Chapter 7. Software tools of global networks.

Topic 7.1. Internet protocols and resources.

Topic 7. 2. Message processing system.

Topic 7. 3. Application software.

Topic 7. 4. Email programs.

Topic 7. 5. Messaging protocols and programs.

Topic 7. 6. Access to Internet resources.

4. Educational materials and resources..

Base:

Larry Peterson and Bruce Davie

1. *Larry Peterson and Bruce Davie Computer Networks: A Systems Approach*<https://book.systemsapproach.org/> 2019

2. *Computer networks. Methodical instructions for laboratory work. [Text] / K.: NTUU "KPI", 2022. - 141 p.; vulture of the faculty (institute); Council protocol number 6; date of receipt of the vulture 06.06.2022*

Education content

5. Methods of mastering an educational discipline (educational component)

| Themes | Hours | | | |
|--|-----------|--------------|-----------|-----------|
| | Total | У тому числі | | |
| | | Lectures | Labs | IW |
| 1 | 2 | 3 | 4 | 5 |
| Chapter 1. Network technologies | | | | |
| Topic 1.1. The aim and task of the course. Evolution of computer networks. | | 1 | | |
| Topic 1.2. Basics of building computer networks | | 1 | | 2 |
| Topic 1.3. Studying the OpNet simulation program | | | | 8 |
| Topic 1.4. Reference model of interaction of open systems | | 1 | | 2 |
| Topic 1.5. Physical environment of transmission of discrete signals | | 1 | | 2 |
| Total in 1 | 18 | 4 | | 14 |
| Chapter 2. Architecture of local computer networks | | | | |
| Topic 2.1. Basic standards of local networks | | 1 | | 4 |
| Topic 2.2. Management of the logical channel of local networks | | 1 | | 5 |
| Topic 2.3. Access of subscriber systems to the common transmission environment | | 2 | | 5 |
| Total in 2 | 18 | 4 | | 14 |
| Chapter 3. Local computer networks | | | | |
| Topic 3.1. 10BASE-5 Ethernet network | | 0.5 | 2 | 1 |
| Topic 3.2. 10BASE-2 Ethernet network | | 0,5 | 2 | 1 |
| Topic 3.3. 10BASE-T Ethernet network | | 1 | 2 | 1 |
| Topic 3. 4. Fast Ethernet network | | 1 | 2 | 1 |
| Topic 3. 5. Gigabit Ethernet network | | 1 | 2 | 1 |
| Topic 3. 6. Token Bus network | | 0,5 | 2 | 1 |
| Topic 3. 7. Token Ring network | | 0,5 | 2 | 1 |
| Topic 3. 8 FDDI network | | 1 | 2 | 1 |
| Total in 3 | 30 | 6 | 16 | 8 |
| Chapter 4. Mobile computer networks. | | | | |
| Topic 4.1. Architecture of wireless networks. | | 1 | | 4 |
| Topic 4.2. Wireless environment of information transmission | | 1 | | 4 |
| Topic 4.3. Management of access to the transmission medium | | 2 | | 2 |
| Topic 4.4. Mobile computer networks (IEEE 802.11. standard) | | 2 | 2 | 4 |
| Total in 4 | 14 | 6 | 2 | 6 |
| Chapter 5. ATM network | | | | |
| Topic 5. 1. Basic principles of ATM technology. | | | 2 | 14 |
| Topic 5.2. The concept of a virtual communication channel | | | | |
| Topic 5.3. Traffic classification. | | | | |

| | | | | |
|---|------------|-----------|-----------|-----------|
| Topic 5.4. Service quality parameters. | | | | |
| Topic 5.5. ATM protocol stack | | | | |
| Topic 5.6. Adaptation level ALL. | | | | |
| Topic 5.7. Categories of ATM protocol services and traffic management | | | | |
| Total in 5 | 22 | 6 | | 16 |
| Chapter 6. Transport level in Internet networks | | | | |
| Topic 6.1. Transport service of computer networks. | | 1 | | 2 |
| Topic 6.2. TCP/IP protocol stack. IP address formats. | | 1 | | 2 |
| Topic 6.3. Functions of the network layer. | | 1 | | 2 |
| Topic 6.4. Route information exchange protocols. | | 1 | | 2 |
| Topic 6.5. Traffic classification. Traffic distribution algorithms. | | 1 | | 1 |
| Topic 6.6. Traffic management | | 1 | | 1 |
| Total in 6 | 16 | 6 | | 10 |
| Chapter 7. Software tools of global networks. | | | | |
| Topic 7.1. Internet protocols and resources. | | 1 | | |
| Topic 7. 2. Message processing system. | | 1 | | |
| Topic 7. 3. Application software. | | 1 | | |
| Topic 7. 4. Email programs. | | 1 | | |
| Topic 7. 5. Messaging protocols and programs | | 1 | | |
| Topic 7. 6. Access to Internet resources. | | 1 | | |
| Total in 7 | 12 | 6 | | 6 |
| Examination | 30 | | | 30 |
| Total in semester | 150 | 36 | 18 | 96 |

Lectures

| № | The name of the topic of the lecture and a list of main questions (a list of didactic tools. References to the literature and tasks on the SRS) |
|----|--|
| 1. | Basics of building computer networks Evolution of computer networks. Topologies of computer networks. Data transmission media |
| 2. | Reference model of open interaction Levels of the reference model. Peculiarities of using the reference model when building a local network. |
| 3. | Architecture of local networks Basic standards of local computer networks |
| 4. | Management of the logical channel of local networks Access of subscriber systems to the common transmission environment |
| 5. | 10BASE-2 10 BASE-2 Ethernet network |
| 6. | 10BASE-T Ethernet network |
| 7. | Fast Ethernet and Gigabit Ethernet networks |
| 8. | Architecture of wireless networks. Wireless environment of information transmission |
| 9. | Mobile computer networks (IEEE 802.11. standard) Management of access to the transmission medium |

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|-----|--|
| 10. | Satellite communication |
| 11. | ATM network Basic principles of ATM technology. The concept of a virtual communication channel |
| 12. | Traffic classification. Service quality parameters |
| 13. | ATM protocol stack Adaptation level ALL. Categories of ATM protocol services and traffic management. |
| 14. | Transport level in Internet networks |
| 15. | TCP/IP protocol stack. IP address formats |
| 16. | Traffic management |
| 17. | Internet protocols and resources |
| 18. | Application software |

Laboratory classes

The purpose of conducting a cycle of laboratory work is to acquire the necessary skills for students practical skills of using methods and ways of organizing computer networks.

Laboratory classes

| No | Labs | Hours |
|----|---|-------|
| 1 | Modeling a 10BASE-5 Ethernet network | 2 |
| 2 | Modeling a 10BASE-2 Ethernet network | 2 |
| 3 | Simulation of the Ethernet 10BASE-T network | 2 |
| 4 | Fast Ethernet network modeling | 2 |
| 5 | Simulating a Gigabit Ethernet network | 2 |
| 6 | Modeling the Token Bus network | 2 |
| 7 | Modeling the Token Ring network | 2 |
| 8 | FDDI network modeling | 2 |
| 9 | Modeling of mobile networks | 2 |
| | Total: | 18 |

6. Independent work of the student

| No | The name of the subject to be studied independently | Кількість годин СРС |
|----|--|---------------------|
| 1 | Basic network technologies Peer-to-peer paradigm Client-server paradigm. Message delivery methods Point-to-point connection Multipoint connections Broadband connections | 4 |
| 2 | ARCHITECTURE OF COMPUTER NETWORKS 35 | 26 |

| | | |
|---|--|-----------|
| | <p>Communication systems of computer networks Managed environment. Coaxial cable. Twisted pair. Fiber optic cable. Types of channels. Synchronization of the data transfer process Data coding Detection and correction of errors. Structure of data frames Frame structure of the DDCMP protocol Manchester Code. Multiplexing. Demultiplexing. Application of multiplexing</p> | |
| 3 | <p>Traffic routing and management. Routing methods. Simple routing. Tabular methods of routing. Dynamic routing. Algorithms for choosing the shortest path. Dijkstra's algorithm. Ford-Fulkerson algorithm. Traffic management levels Traffic management at the data link level. Traffic management at the network level. Regulation of the intensity of incoming traffic.</p> | 22 |
| 4 | <p>ATM network ATM cells. Virtual channels and virtual paths. Establishing connections in the ATM network. System architecture of the ATM network. ATM adaptation level protocols. Structure of ATM adaptation level. Routing in ATM networks. PNNI protocol. Exchange of route information</p> | 22 |
| 5 | <p>MPLS network technology. Main features of MPLS. The process of functioning of MPLS. The relationship between PE- and P-routing. Advantages of MPLS. QoS support. Creating VPN connections using MPLS.</p> | 22 |
| | Total | 96 |

7. Policy of academic discipline (educational component)

During classes in an academic discipline, students must adhere to certain disciplinary rules:

- 1) it is forbidden to be late for classes;
- 2) at the entrance of the teacher, as a sign of greeting, persons studying at KPI named after Igor Sikorsky should stand up;
- 3) extraneous conversations or other noise interfering with classes are not allowed;
- 4) leaving the classroom during the lesson is allowed only with the teacher's permission.
- 5) it is not allowed to use mobile phones and other technical means without the teacher's permission.

Laboratory works are submitted in person with a preliminary check of theoretical knowledge, which is necessary for the performance of laboratory work. Validation of practical results includes code review and execution of test tasks.

In the course of training, the teacher has the right to award up to 5 incentive points for the early completion of laboratory work, for the demonstrated creative approach when performing an individual task or for active participation in the discussion of issues related to the topic of the lecture or practical session.

The teacher may assign up to 5 penalty points for completing and submitting laboratory work after the specified deadline, for a significant number of missed classes, or for violating the rules of behavior in classes

8. Types of control and rating system for evaluating learning outcomes (RSO)

-Current control: execution of modular control work

Calendar control: is carried out twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.

Semester control: exam

Conditions for admission to semester control: semester rating of more than 40 points.

Evaluation of individual types of educational work performed by the student is carried out in points:

| View educational work | Point | Points |
|---|-------|------------|
| Performance and protection of laboratory work 1 | 5 | 45 |
| Performance and protection of laboratory work 2 | 5 | |
| Performance and protection of laboratory work 3 | 5 | |
| Performance and protection of laboratory work 4 | 5 | |
| Performance and protection of laboratory work 5 | 5 | |
| Performing and protecting laboratory work 6 | 5 | |
| Performance and protection of laboratory work 7 | 5 | |
| Performance and protection of laboratory work 8 | 5 | |
| Performance and protection of laboratory work 9 | 5 | |
| Modul control work | | 15 |
| Examen | | 40 |
| Total | | 100 |

Table of correspondence of rating points to grades on the university scale:

| Scores | Rating |
|------------------------------|------------------|
| 100-95 | Perfectly |
| 94-85 | Very well |
| 84-75 | Okay |
| 74-65 | Satisfactorily |
| 64-60 | Enough |
| Less than 60 | Unsatisfactorily |
| Admission conditions not met | Not allowed |

9. Additional information on the discipline (educational component)

Conditions for crediting additional points.

As part of studying the academic discipline « Computer networks »

points obtained as a result of distance courses are allowed to be credited to the “Coursera” platform, subject to prior approval of the program of this course from teacher and on the condition of obtaining an official certificate.

Working program of the academic discipline (syllabus):

Compiled by Yu.O. Kulakov, professor of the Department of Computer Engineering, Doctor of Technical Sciences.

Approved by the Department of Computing (Protocol No. 10 dated 05/25/2022)

Agreed by the Methodical Commission of the faculty (protocol No. 10 dated 06/09/2022)

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