[RE-46] BASICS OF INTERNET TECHNOLOGIES AND COMPUTER NETWORKS

Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	17 - Electronics, Automation, and Electronic Communications
Specialization	172 - Electronic Communications and Radio Engineering
Educational program	All educational programs
Discipline status	Elective (F-catalog)
Form of higher education	Full-time
Year of training, semester	
	Available for selection starting from the 3rd year, fall semester
Scope of the discipline	4 credits (Lectures 18 hours, Practical classes 36 hours, Laboratory work 36 hours, Independent work 64 hours)
Semester Control/control measures	Exam
Class schedule	https://schedule.kpi.ua
Language of instruction	Ukrainian
Information about the course coordinator/teacher s	Lecturer: Litvintsev S. M., Lab: Litvintsev S. M., Independent work: Litvintsev S. M.
Course placement	https://do.ipo.kpi.ua/course/view.php?id=6044

Curriculum

1. Description of the course, its purpose, subject matter, and learning outcomes

The course "Fundamentals of Internet Technologies and Computer Networks" is one of the courses that provides students with knowledge about Internet technologies that are now widely used and deepens their existing understanding of computer networks. This subject develops existing theoretical knowledge and practical skills in building, managing, modernizing, monitoring and analyzing the performance, diagnostics and troubleshooting of modern electronic networks and communications, and their application in communications via the Internet.

After completing the course, students should demonstrate the following learning outcomes:

1) Knowledge:

• basic means of communication technology for creating computer networks, their classification and characteristics;
• the purpose, features of operation, and concepts of building local and global computer networks; • basic technologies of local computer networks and features of their application;
• the basics of the organization and functioning of global computer networks and the services provided to users by such networks;
• the composition and purpose of software tools that ensure the effective and uninterrupted operation of modern computer technologies;
• the domain name system;
• universal resource locator (URL);
• the logical structure of HTML documents and websites; •

principles of search engine construction.

2) Skills:

• select and justify the choice of model for building a projected computer network, network architecture, type of cable system, configuration of network equipment necessary to ensure the normal operation of a computer network;
• plan and implement computer networks, manage network resources;
• select a set of necessary hardware and software tools for the implementation of a computer network;
• expand and modernize networks, diagnose and solve problems that arise in them; • apply modern technologies (VLAN, PoE, DHCP, etc.) when building networks;
• use Internet search engines;
• create, fill, and ensure the functioning of websites and web communities on the Internet; •
create HTML documents and websites using modern software tools.

3) Experience: based on the knowledge and skills acquired, the specialist will be able to solve professional tasks based on modern technologies and methods of building computer networks and create HTML documents and websites.

After completing the course, students should demonstrate the following program competencies and learning outcomes according to the educational program (see https://osvita.kpi.ua/op):

General competencies

GC-2 – Ability to apply knowledge in the processing of results or random signals.

GC-4 – Knowledge and understanding of the subject area and understanding of professional activities.

GC-8 – Ability to identify, pose, and solve problems.

Special (professional, subject-specific) competencies

PC-1 – Ability to understand the essence and significance of information in the development of a modern information society.

PC-2 – Ability to solve standard tasks of professional activity using information and communication technologies and taking into account the basic requirements of information security.

PC-3 – Ability to use basic methods, techniques, and tools for obtaining, transmitting, processing, and storing information.

PC-4 – Ability to perform computer modeling of devices, systems, and processes using universal application software packages.

PC-5 – Ability to use regulatory and legal documentation related to information and telecommunications

networks (laws of Ukraine, technical regulations, international and national standards, recommendations of the International Telecommunication Union, etc.) to solve professional tasks.

PC-6 – Ability to perform instrumental measurements in information and telecommunications networks and telecommunications systems.

PC-8 – Willingness to promote the implementation of promising technologies and standards.

PC-10 – Ability to install, debug, configure, adjust, test, and commission telecommunications equipment.

PC-11 – Ability to compile regulatory documentation (instructions) for the operational and technical maintenance of information and telecommunications networks and telecommunications systems, as well as for testing programs.

PC-12 – Ability to perform work related to managing the load flows of information and telecommunications networks.

PC-15 – Ability to perform calculations in the process of designing information and telecommunications networks and telecommunications systems in accordance with technical specifications using both standard and independently developed methods, techniques, and design automation software.

Learning outcomes

• analyze, argue, and make decisions when solving specialized tasks and practical problems in telecommunications, which are characterized by complexity and incomplete certainty of conditions;
• apply the results of personal research and analysis of information to solve qualitative and quantitative problems of a similar nature in information and communication networks and telecommunications systems;
• explain the results obtained from measurements in terms of their significance and relate them to the relevant theory;
• skills in evaluating, interpreting, and synthesizing information and data;
• adapt to changes in information and communication network technologies and telecommunications systems;
• properly apply telecommunications industry terminology;
• describe the principles and procedures used in telecommunications systems and information and telecommunications networks;
• analyze and evaluate the effectiveness of methods for designing information and telecommunications networks and telecommunications systems;
• tolerantly perceive and apply ethical standards of behavior towards other people;
• apply fundamental and applied sciences to analyze and develop processes occurring in telecommunications systems;
• apply an understanding of the basic properties of the component base to ensure the quality and reliability of telecommunications systems and devices;
• apply an understanding of the means of automation of design and technical operation of telecommunications systems in professional activities;
• applying an understanding of the basics of metrology and standardization in the field of telecommunications in professional activities;
• understanding and complying with domestic and international regulatory documents on the development, implementation, and technical operation of information and telecommunications networks and telecommunications systems;
• find, evaluate, and use information from various sources necessary for solving professional tasks, including reproducing information through electronic search;
• perform standard tests of information and communication networks and telecommunication systems for compliance with the requirements of domestic and international regulatory documents;
• explain the principles of construction and operation of hardware and software complexes of control and maintenance systems for the development, analysis, and operation of information and telecommunications networks and telecommunications systems;
• ensure the reliable and high-quality operation of information and communication networks and telecommunications systems;
• monitor the technical condition of information and communication networks and telecommunications

systems during their technical operation in order to identify deterioration in performance or failures, and systematically record this through documentation.

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

To master this discipline, knowledge of the following disciplines is required: "Computer Science 1. Fundamentals of Programming and Algorithms", "Computer Science 2. Fundamentals of Computing", "OTKRT 1 Fundamentals of Electronic Communications Networks".

The knowledge gained in this discipline will ensure mastery of the following disciplines: "Fundamentals of Signal Coding and Encryption Theory," "Radio Systems for Various Purposes," "Machine Learning in Radio Engineering Computerized Systems," "Technical Protection in Information Systems," "Information Security," "Mobile Communication Systems," "New Generation Mobile Communication Systems," and "Web Services and Applications."

3. Course content

I. Fundamentals of computer networks Section

1. Principles of network construction and

elements Topic 1.1. Rating System
Topic 1.2. The role of the network
Topic 1.3. Topology, network components

Topic 1.4. Wireless, mobile, global networks

Section 2. Network Architecture

Topic 2.1. The Concept of Architecture

Topic 2.2. Terminal-mainframe architecture
Topic 2.3. Client-server architecture
Topic 2.4. Peer-to-peer architecture
Topic 2.5. Computer-network architecture
Topic 2.6. Intelligent network architecture

Section 3. Network models
Topic 3.1. OSI and TCP/IP reference models

Topic 3.2. OSI protocol stack
Topic 3.3. TCP/IP protocol stack
Topic 3.4. Microsoft TCP/IP protocol stack
Topic 3.5. IPX/SPX protocol stack
Topic 3.6. Comparison of models

Section 4. Access methods

Topic 4.1. General characteristics
Topic 4. 2 CSMA/CD access method
Topic 4.3 CSMA/CA access method
Topic 4.4 TPMA access method
Topic 4.5. DPP access method

Section 5. Communication channels and lines

Topic 5.1. Concept of a communication
channel
Topic 5.2. Types of communication lines

Topic 11.8. Web forums, blogs, wiki projects, online stores, online advertising

Topic 11.9. IP telephony, VoIP, IP radio, IPTV

Topic 11.10. Cloud computing

Section 12. FTP servers

Topic 12.1. What is an FTP server?

Topic 12.2. Why do you need an FTP server? Topic

12.3. How does the FTP protocol work?

Topic 12.4. Installing and configuring an FTP server Topic

12.5. How to connect to an FTP server

Section 13. Web servers

Topic 13.1. Basic functions of web servers

Topic 13.2. Criteria for choosing web servers

Topic 13.3. Overview of web servers (Apache, IIS, lighttpd, Google Web Server)

Topic 13.4. Web server security and causes of vulnerability

Topic 13.5. Planning web server deployment

Topic 13.6. Security of the OS on which the web server is installed

Topic 13.7. Installation and configuration of the web server

Chapter 14. HTML Basics

Topic 14.1. What is HTML

Topic 14.2. How HTML works

Topic 14.3. Most commonly used HTML tags

Topic 14.4. General structure of an HTML file

Topic 14.5. Built-in tags

Topic 14.6. Differences between HTML and HTML5

Topic 14.7. Pros and cons of HTML

Topic 14.8. How HTML, CSS, and JavaScript are related

Topic 14.9. Tools for creating HTML

Chapter 15. Content management systems Topic

15.1. Content and content management

Topic 15.2. CMS content management systems

Topic 15.3. Technical structure of CMS

Topic 15.4. CMS model

Topic 15.5. Document management system

Topic 15.6. Standards in CMS

Topic 15.7. Classification of CMS systems

Topic 15.8. Characteristics of CMS

Topic 15.9. Development of CMS

Topic 15.10. Commercial CMS systems

Topic 15.11. "Open" CMS systems

PP from the module Test

4. Teaching materials and resources

Basic recommended reading

1. Tarnavskyi, Yu. A., Kuzmenko, I. M. *Organization of Computer Networks*. Kyiv: KPI, 2018. 259 p.

2. Vorobienko P. P., Nikitiuk L. A., Reznichenko P. I. *Telecommunications and Information Networks* : Textbook for Higher Education Institutions. Kyiv: SUMMIT-Book, 2010. 708 p.

3. Mykityshyn, A. G., Mytnik, M. M., Stukhlyak, P. D., Pasichnyk, V. V. *Computer Networks* [textbook]. — Lviv: Magnolia 2006, 2013. 256 p.

4. Pogorily S. D., Kalita D. M. *Computer Networks. Hardware and Data Transmission Protocols:*

Textbook for Students of Higher Education Institutions, edited by O. V. Tretyak. Kyiv: Kyiv University, 2007. 455 p.

Recommended supplementary reading

1. Bilous L. F. *Information Networks: Textbook*. Kyiv: Logos, 2005. 140 p.
2. Stallings W. *Computer Networking with Internet Protocols and Technology*. 2004. 640 p.
3. Kulakov Yu. O., Lutsky G. M. *Computer Networks*. Kyiv: Junior, 2003. 400 p.

Educational content

5. Methodology for mastering the academic discipline (educational component)

Lectures

No	Lecture topic and list of main questions
1	*Principles of network construction and elements* RCO. The role of the network. Topology, network components. Wireless, mobile, global networks
2	*Network architecture* The concept of architecture. Terminal-mainframe architecture. Client-server architecture. Peer-to-peer architecture. Computer-network architecture. Intelligent network architecture
3	*Network models* Reference models OSI, TCP/IP. OSI protocol stack. TCP/IP protocol stack. Microsoft TCP/IP protocol stack. IPX/SPX protocol stack. Comparison of models
4	*Access methods* General characteristics. CSMA/CD access method. CSMA/CA access method. TPMA access method. DPP access method

5		*Communication channels and lines* The concept of a communication channel. Types of communication lines. Cable systems. Structured cable network
6		*Communication line characteristics* Types of characteristics. Amplitude-frequency characteristic. Bandwidth. Noise immunity. Data transmission reliability. Nyquist and Shannon formulas
7		*Ethernet cable systems* Types of Ethernet. 10BASE5 Ethernet. 10BASE2 Ethernet. 10BASE-T Ethernet. 10BASE-FL Ethernet. 100BASE-TX Ethernet. 100BASE-T4 Ethernet. 100BASE-FX Ethernet
8		*Addressing in IP networks* Address space and types of addresses. Local addresses (MAC). Network addresses (IP). Network addresses (IP). Character addresses (DNS). Calculation of IPv4 subnets. IPv6 and its comparison with IPv4
9		*Management in computer networks* NAT (Network Address Translation). DHCP (Dynamic Host Configuration Protocol). VLAN (Virtual Local Area Network). PoE (Power over Ethernet)
10		*Network technologies in Windows* Static and dynamic IP assignment, verification. IPCONFIG command. PING command. ARP command. TRACERT command. NSLOOKUP command. Troubleshooting network problems
11		*Basic Internet resources* Management, access (Telnet). File transfer (FTP, SFTP, TFTP). Electronic mail (SMTP). World Wide Web (WWW). Uniform Resource Locator (URL)
12		*Main Internet resources* Search engines. IM (Instant Messaging) messengers. Web forums, blogs, wiki projects, online stores, online advertising. IP telephony, VoIP, IP radio, IPTV. Cloud computing
13		*FTP servers* What is an FTP server? Why do you need an FTP server? How does the FTP protocol work? Installation and configuration of an FTP server. How to connect to an FTP server
14		*Web servers* Basic functions of web servers. Criteria for choosing web servers. Overview of web servers (Apache, IIS, lighttpd, Google Web Server). Web server security and causes of vulnerability. Planning the deployment of a web server. Security of the OS on which the web server is installed. Installation and configuration of a web server
15		*HTML basics* What is HTML. How HTML works. Most commonly used HTML tags. General structure of an HTML file. Embedded tags.
16		*HTML basics* How HTML and HTML5 differ. Pros and cons of HTML. How HTML, CSS, and JavaScript are related. Tool for creating HTML
17		*Content management systems* Content and content management. Content management systems (CMS). Technical structure of CMS. CMS model. Document management system. Standards in CMS
18		*Content management systems* Classification of CMS systems. Characteristics of CMS. Development of CMS. Commercial CMS systems. "Open" CMS systems

Offline laboratory classes

No.	Name of the session topic and list of main questions
1	Creating a peer-to-peer network and sharing network resources using TP-Link equipment Studying the web interface for configuring TP-Link equipment
2	Creating a peer-to-peer network and sharing network resources using MiktoTik equipment. Learning the RouterOS operating system Configuring and using DHCP and DNS services
3	Creating a local network using VLAN
4	Configuring an FTP server and creating a peer-to-peer network to provide shared access to the server
5	Configuring a web server on a local computer and creating a business card website using HTML
6	Configuring a web server on a local computer, installing a content management system, and creating a business card website

6. Independent work

Students must prepare for lectures and lab classes in advance. Before lectures, it is necessary to review the theoretical material that was provided in previous lectures or assigned in advance.

Homework assignments for lab sessions must be completed before the next session.

In order to better assimilate the course material, a calculation assignment (CA) is planned. To prepare for the calculation assignment, students should use the recommended literature, lecture notes, and methodological guidelines for completing the CA. Individual assignments for the calculation assignment are given by the instructor, who also sets deadlines for its submission. The following is performed in the CR:

1. Designing the network structure.
2. Calculations of subnets when distributing allocated IP ranges.
3. Construction of the proposed network structure in a software emulator.
4. Verification of network performance by building it from real elements.
5. Creating a business card website.
6. Checking the functionality of the business card website in the created local network.

The final exam covers some theoretical issues, which are explained during the lecture.

Policy and control

7. Academic discipline (educational component) policy Class

attendance

Attendance at lectures and laboratory classes — in accordance with the Regulations on the organization of the educational process at Igor Sikorsky Kyiv Polytechnic Institute. At least once every two weeks, the teacher conducts consultations on various issues of the credit module. During consultations, the teacher can provide assistance in studying the material of classes that

students have missed for various reasons and must master on their own.

In any case, students are encouraged to attend all types of classes, as they cover theoretical material and develop the skills necessary for completing homework and calculations.

Missed tests

The result for a student who did not attend a test is zero. If a student misses a test for a valid reason, they are given the opportunity to make it up (complete the laboratory work) in the presence of the teacher. If the absence occurred without a valid reason, the issue of making it up is decided with the teacher in agreement with the department management. A missed test is not counted regardless of the reason for the absence; in this case, the student receives a "did not show up" mark, and if they are eligible to take the test, they must take it during an additional session.

Announcement of test results

The defense of the completed section of the calculation work takes the form of an interview with the teacher. During the defense, the student must be able to explain the results obtained and answer the main theoretical questions on the topics of the sections. The results of the defense are announced to the student in their presence or remotely and are accompanied by specific comments and remarks regarding errors (remote communication via Discord, Zoom, or Telegram with video and audio).

The results for the completed laboratory work are posted after its completion and defense.

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute." For more details, see: https://kpi.ua/code.

Standards of ethical conduct

The standards of ethical conduct for students and employees are set out in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute." For more details, see: https://kpi.ua/code.

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the procedure for conducting and/or evaluating tests and expect that it will be considered in accordance with predetermined procedures.

Students have the right to appeal the results of assessment measures, but must provide a reasoned explanation of which criteria they disagree with according to the assessment sheet and/or comments.

8. Types of assessment and the learning outcomes assessment rating system (LOAS)

The **LOAS** is based on a 100-point scale, which allows students to earn the necessary points during the semester and receive an automatic grade for the course (more than 60 points) or take a differential exam.

No.	Control measure	Maximum points	Number	Total
1	Attendance at lectures (test after lecture)	2	9	18
2	Work in laboratory classes	10	6	60

3.	Calculation work	20	1	20
5.	Bonuses	8	1	8
6.	Credit (if you did not score 60)	40	1	40
	Total			100

Table of correspondence between rating points and university scale grades

Number of points	**Grade**
100-95	Excellent
94	Very good
84	Good
74-65	Satisfactory
64-60	Sufficient
Less than 60	Unsatisfactory
Admission requirements not met	Not admitted

9. Additional information on the discipline (educational component)

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Description of material, technical, and informational support for the discipline

Laboratory work is carried out in the network technology training laboratory, which has the following equipment:

- TP-Link L2 switches (10 pcs)
- Cisco L2 switches (6 pcs)
- Cisco L3 switches (2 pcs)
- Mikrotik routers (10 pcs)

Work program for the academic discipline (syllabus):
Compiled by Litvintsev S. M.;
Approved by the RI Department (Minutes No. 06/2024 dated 06/27/2024)
Approved by the methodological commission of the faculty/research institute (protocol No. 06/2024 dated 28.06.2024)