Національний технічний університет України «КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ імені ІГОРЯ СІКОРСЬКОГО»	Faculty of Radio Engineering Department of Radio Engineering

Fundamentals of Electronic Communications Networks (GT 15)

Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education	***First (bachelor's)***
Field of knowledge	*17 Electronics, Automation, and Electronic Communications*
Special	*172 Electronic Communications and Radio Engineering*
Educational program	*Radio Engineering Computerized Systems* *Radio Electronic Warfare Technologies* *Intelligent radio- electronic engineering technologies* *Information and Communication Radio Engineering*
Status of the discipline	*Compulsory general training*
Form of study	*Full-time (day)*
Year of training, semester	*2nd year, spring semester*
Scope of the discipline	*Total: 3 ECTS credits/90 hours Lectures: 18 hours* *Laboratory classes: 36 hours* *Independent work by students: 36 hours.*
Semester control/ assessment	*Modular test, homework control test, final test, current assessment/defense of laboratory work*
Class schedule	*Lectures (once a week starting from the 1st week Laboratory work (once every two weeks, preferably after the lecture)*
Language of teaching	*Ukrainian*
Information about the course supervisor/teachers	*Lecturer: Ph.D., Associate Professor of the Department of Radio Engineering* ***Sergii Litvintsev*** *(Litvintsev.Sergii@LLL.kpi.ua),* *+38 094 821 37 72* *Laboratory work: Ph.D., Associate Professor, Department of Radio Engineering* ***Sergii Litvintsev*** *Associate Professor, Ph.D., Associate Professor of the Department of Radio Engineering* ***Olena Grygorenko***
Course location	*The course is available on the Sikorsky distance learning platform:* *https://do.ipo.kpi.ua/course/view.php?id=5814*

Curriculum

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

The academic discipline "Fundamentals of Electronic Communications Networks" is one of the basic disciplines that broadens the horizons of any radio engineer. This subject develops theoretical

knowledge and practical skills in the construction, management, modernization, monitoring and analysis of performance, diagnostics and troubleshooting of modern electronic networks and communications.

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 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 tools, that ensure the and uninterrupted operation of modern computer technologies.

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.

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

In accordance with the educational and professional programs (EPP) of the first "bachelor's" level of higher education, after mastering the academic discipline, students should acquire **the** following program **competencies**:

General competencies (GC)

GC02 – Ability to apply knowledge in practical situations.
GC04 – Knowledge and understanding of the subject area and understanding of professional activity.
GC07 – Ability to learn and master modern knowledge.
GC08 – Ability to identify, pose, and solve problems.

Professional competencies (PC)

PC02 – Ability to solve standard tasks of professional activity based on information and bibliographic culture using information and communication technologies and taking into account the basic requirements of information security.
PC03 – Ability to use basic methods, means, and tools for obtaining, transmitting, processing, and storing information.
PC05 – Ability to use regulatory and legal documentation related to information and telecommunications networks, telecommunications and radio engineering systems (laws of Ukraine, technical regulations, international and national standards, recommendations of the International Telecommunication Union, etc.) to solve professional tasks.
PC08 – Willingness to promote the implementation of promising technologies and standards.

PC10 – Ability to install, debug, configure, adjust, test, and commission telecommunications and radio engineering structures, facilities, and equipment.
PC11 – Ability to compile regulatory documentation (instructions) for the operational and technical maintenance of information and telecommunications networks, telecommunications and radio engineering systems, as well as for testing programs.
PC12 – Ability to perform work related to managing the load flows of information and telecommunications networks.

Program learning results (PLR)

According to the first "bachelor's" level of higher education, as a result of mastering the academic discipline, students must demonstrate the following **program learning results**:
PLR02 – Apply the results of personal search and analysis of information to solve qualitative and quantitative problems of a similar nature in information and communication networks, telecommunications and radio engineering systems.
PLR04 – Explain the results obtained as a result of measurements in terms of their significance and relate them to the relevant theory.
PLR06 – Adapt to changes in information and communication networks, telecommunications and radio engineering systems.
PLR07 – Competently apply terminology in the field of telecommunications and radio engineering.
PLR08 – Describe the principles and procedures used in telecommunications systems, information and telecommunications networks, and radio engineering.
PLR09 – Analyze and evaluate the effectiveness of methods for designing information and telecommunications networks, telecommunications and radio engineering systems.
PLR15 – Apply understanding of automation tools for the design and technical operation of telecommunications and radio engineering systems in professional activities.
PLR17 – Understand and comply with domestic and international regulatory documents on the development, implementation, and technical operation of information and telecommunications networks, telecommunications, and radio engineering systems.
PLR18 – Finding, evaluating, and using information from various sources necessary for solving professional tasks, including reproducing information through electronic search.
PLR19 – Perform standard tests of information and communication networks, telecommunications and radio engineering systems for compliance with the requirements of domestic and international regulatory documents.
PLR20 – 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, telecommunications, and radio engineering systems.
PLR21 – Ensure the reliable and high-quality operation of information and communication networks, telecommunications and radio engineering systems.
PLR22 – Monitor the technical condition of information and communication networks, telecommunications and radio engineering 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)

In the structural-logical scheme of the educational and professional program for training specialists of the first (bachelor's) level of higher education, the academic discipline "Fundamentals of Electronic Communications Networks" is included in the list of normative disciplines aimed at forming the general competencies of a specialist.

Prerequisites – "Higher Mathematics."

Post-requisites – "Signals and Processes in Radio Engineering."
It is an integral part of the integrated competence of the first (bachelor's) level of higher education.

3. Contents of academic discipline

Section 1. Principles of design and elements of network
- Topic 1.1. Learning rating system (LRS)
- Topic 1.2. Role of network
- Topic 1.3. Basic principles of design
- Topic 1.4. Basic terms
- Topic 1.5. Network topology
- Topic 1.6. Passive components of wired network
- Topic 1.7. Active network components
- Topic 1.8. Wireless networks
- Topic 1.9. Mobile networks
- Topic 1.10. Global networks

Section 2. Network models
- Topic 2.1. OSI Reference Model
- Topic 2.2. TCP/IP protocol stack
- Topic 2.3. Comparison of OSI and TCP/IP

Section 3. Addressing in TCP/IP
- Topic 3.1. Addressing in Networks
- Topic 3.2. Subnet Classes
- Topic 3.3. Subnet mask
- Topic 3.4. Subnet calculation
- Topic 3.5. IP assignment, static, dynamic, verification
- Topic 3.6. DNS addresses

Section 4. Protocols in network
- Topic 4.1. Encapsulation in computer networks
- Topic 4.2. Overview of basic stack protocols
- Topic 4.3. ARP protocol
- Topic 4.4. IP Protocol: IP Addresses, IP Packet Structure
- Topic 4.5. UDP Protocol
- Topic 4.6. TCP Protocol

Section 5. Management in computer networks
- Topic 5.1. NAT (Network Address Translation)
- Topic 5.2. DHCP (Dynamic Host Configuration Protocol)
- Topic 5.3. VLAN (Virtual Local Area Network)

Section 6. TCP/IP application layer
- Topic 6.1. HTTP (HTTPS) protocol
- Topic 6.2. SMTP Protocol (mail delivery)
- Topic 6.3. File Transfer Protocol (FTP, SFTP, TFTP)
- Topic 6.4. Telnet
- Topic 6.5. SNMP (Simple Network Management Protocol)

Chapter 7. Wireless Networks
- Topic 7.1. Classification of wireless technologies
- Topic 7.2. Principles of construction

Topic 7.3. Wi-Fi and Ethernet
Topic 7.4. Wi-Fi Physical Layer Standards
Topic 7.5. Signal Representation
Topic 7.6. Wi-Fi Speed Adaptation
Topic 7.7. Wi-Fi Problems
Topic 7.8. Wi-Fi Collisions
Topic 7.9. CSMA/CA model
Topic 7.10. Wi-Fi security
Topic 7.11. Wi-Fi vs LTE

Chapter 8. Basic Network Diagnostics
Topic 8.1. PING command
Topic 8.2. ARP command
Topic 8.3. IPCONFIG command
Topic 8.4. TRACERT command
Topic 8.5. NSLOOKUP command

Chapter 9. TCP/IP and Applications
Topic 9.1. Winsock
Topic 9.2. NetBIOS
Topic 9.3. TCP/IP and Troubleshooting

Chapter 10. Modern Technologies and Computer Network Security
Topic 10.1. PoE (Power over Ethernet)
Topic 10.2. DMZ (Demilitarized Zone)
Topic 10.3. VPN
Topic 10.4. Proxy
Topic 10.5. Traffic Analysis

Chapter 11. Routing
Topic 11.1. Static Routing
Topic 11.2. Dynamic Routing
Topic 11.3. Routing Protocols

Chapter 12. Services using TCP/IP
Topic 12.1. IP telephony
Topic 12.2. IPTV (Internet Protocol television)
Topic 12.3. NAS (network attached storage)
Topic 12.4. Cloud services (public cloud services)
Topic 12.5. Virtualization
Topic 12.6. IoT (Internet of Things)

Modular test (MT)
Home control work (HCW)
Final test

4. Teaching materials and resources

Basic and additional literature (hereinafter referred to as literature) is used to prepare for lectures, laboratory classes, modular tests, independent work, etc. The literature that must be used to master the discipline is studied by students independently using Internet resources, on the Sikorsky distance learning platform using the Moodle platform. In the context of distance learning, literature available in electronic form on university and external media may be used.

Basic literature

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. Tannenbaum, E. *Computer Networks*. St. Petersburg, 2003. 992 p.
4. Mykityshyn, A. G., Mytnik, M. M., Stukhlyak, P. D., Pasichnyk, V. V. *Computer Networks* [textbook]. Lviv: Magnolia 2006, 2013. 256 p.
5. Pogorily S. D., Kalita D. M. *Computer Networks. Hardware and Data Transmission Protocols: Textbook for Students of Higher Educational Institutions*, edited by O. V. Tretyak. Kyiv: Kyiv University, 2007. 455 p.

Additional literature

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.

Information resources

1. https://2ip.ua/ua/ – online network tools.
2. https://www.imena.ua/ua – Ukraine's largest domain name registrar.

Educational content

5. Methodology for mastering academic discipline (educational component)

Nine lectures and nine laboratory classes are planned for studying the academic discipline, during which students must complete a modular test, control tests after attending lectures, and defend their laboratory work after completing it.

Lectures

No	Lecture topic and list of main questions
1	Principles of network construction and elements LRS. The role of the network. Basic principles of construction. Key terms. Network topology. Passive components of a wired network. Active network components. Wireless networks. Mobile networks. Global networks
2	Network models and addressing in TCP/IP OSI reference model. TCP/IP protocol stack. Comparison of OSI and TCP/IP. Addressing in TCP/IP Addressing in networks Subnet classes. Subnet mask. Subnet calculation. IP assignment, static, dynamic, verification. DNS addresses
3	Network protocols
	Encapsulation in computer networks. Overview of the main stack protocols. ARP protocol. IP protocol: IP address, IP packet structure. UDP protocol. TCP protocol
4	Management in computer networks NAT (Network Address Translation). DHCP (Dynamic Host Configuration Protocol). VLAN (Virtual Local Area Network).

5	TCP/IP application layer HTTP protocol (https). SMTP protocol (mail delivery). File Transfer Protocol (FTP, SFTP, TFTP). Telnet. SNMP.
6	Wireless networks Classification of wireless technologies. Principles of construction. Wi-Fi and Ethernet. Wi-Fi physical layer standards. Signal representation. Wi-Fi speed adaptation. Wi-Fi problems. Collisions in Wi-Fi. CSMA/CA model. Wi-Fi security. Wi-Fi vs LTE
7	Minimum network diagnostics PING command. ARP command. IPCONFIG command. TRACERT command. NSLOOKUP command. TCP/IP and applications: Winsock. NetBIOS. TCP/IP and troubleshooting.
8	Modern technologies and computer network security PoE (Power over Ethernet) Computer network protection DMZ (Demilitarized Zone). VPN. Proxy Network testing and traffic analysis
9	Routing Static routing. Dynamic routing. Routing protocols Services using TCP/IP IP telephony. IPTV (Internet Protocol television). NAS (network attached storage). Cloud services (public cloud services) Virtualization Internet of Things (IoT)

Laboratory classes (offline)

No.	Name of class topic and list of main questions
1	**Lab work No. 1.** **Passive components, MAC and IP addresses** Crimping and testing twisted pair cable systems. Using MAC and IP addressing in networks. Creating a peer-to-peer network and sharing network resources using TP-Link equipment Studying the web interface for configuring TP-Link equipment
2	**Lab work No. 2.** **Managed L2 switches in networks** Studying the IOS (Cisco) operating system Resetting of equipment Cisco to factory settings and initial settings Creating the simplest network based on Cisco equipment
3	**Lab work No. 3.** **VLAN technology in networks** Studying VLAN technology based on Cisco equipment
	Creating one-level network using Cisco equipment and VLAN technology on single switch Creating one-level network using Cisco equipment on multiple switches with VLAN technology and trunks

4	**Lab work No. 4.** **Default gateway and DNS service** Studying the RouterOS (Mikrotik) operating system Creating two simple networks and connecting them using a default gateway. Studying the routing process in a network Configuring the DNS service in the network and checking its performance
5	**Lab work No. 5.** **DHCP service and Wi-Fi interface** Configuring the DHCP service in the network and checking its performance Studying the operation of wireless networks on MiktoTik equipment Configuring a wireless interface as an access point and checking its operation
6	**Lab work No. 6.** **Troubleshooting in local computer networks** Studying the features of Cisco L3 switch configuration and operation Team building of a local network that is similar in parameters to a real office network Creating, searching for, and solving problems in a working network

Distance learning platform

For better assimilation of the subject matter during remote work, we use email, the Sikorsky distance learning platform based on Moodle, and the Google Meet and ZOOM platforms for online meetings, which make it easier to post methodological recommendations, training materials, literature, etc.

- simplify the placement of methodological recommendations, training materials, literature, etc.
- provide feedback to students on learning tasks and the content of the academic discipline;
- completed assignments are checked and evaluated;
- keeping track of students' progress in the course, adherence to the schedule for submitting educational/individual assignments, and their assessment.

6. Independent work of students (SS)

Independent work (self-study) includes: preparation for lectures and laboratory classes; self-assessment of acquired knowledge; study of recommended sources and literature; preparation for modular tests; preparation for homework assignments, preparation for exams, etc. Independent work includes the study of certain theoretical issues, which are introduced during lectures.

Preparation for lectures

To prepare for lectures, students must study the planned basic and supplementary literature and recommended sources. Before lectures, students must review the theoretical material that was presented in previous lectures or assigned in advance. Students are allocated approximately 1 hour for each topic of the discipline.

Preparation for laboratory classes

Students must prepare for laboratory classes in advance. Homework assignments for laboratory classes are listed in the corresponding methodological guide. Assignments must be completed before the start of the corresponding laboratory class.

Modular test (MT)

Up to 2 hours are allocated for preparation for the MT. A list of questions for preparation for the MT is provided in Appendix B.

Home control work (HCW)

In order to better assimilate the course material, a homework assignment is planned, which is presented in the form of an analysis and calculation of a real network. To prepare for the homework assignment, students should use the recommended literature, lecture notes, and methodological guidelines. Individual assignments for the homework assignment are given by the instructor, who also sets deadlines for its completion. The homework assignment includes:

1. Analysis of the existing network
2. Subnetwork calculations 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 (if necessary).

Final test

The test is conducted during the semester control period (test week), at the end of the academic semester after students have written a modular test and a home test, based on the results of the rating points earned during the semester or, at the discretion of the instructor, by writing a test paper. Six hours of class time are allocated for preparation for the exam. A list of questions for exam preparation is provided in Appendix A. During the distance learning period, the exam may be conducted according to the class schedule using Moodle and the Google Meet and ZOOM online meeting platforms.

Policy and control

7. Academic discipline (educational component) policy

Class attendance

Attendance at lectures and laboratory classes is in accordance with the Regulations on the Organization of the Educational Process at Igor Sikorsky KPI. At least once every two weeks, the instructor holds consultations on various issues related to the credit module. During consultations, the instructor 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 to complete homework assignments and module tests.

Rules for completing assignments

When working on the material of the subject "Fundamentals Electronic Communications Networks," students:

1) during lectures:

- take periodic quick tests of residual knowledge from sections of the academic discipline, which may include creative tasks on topics not covered in lectures, or quick test tasks (lasting 5–10 minutes using tests on the Sikorsky platform);
- complete a modular test using the Sikorsky platform;

2) in laboratory classes:

- prepare homework assignments based on their own tasks based on the study of sources and literature;
- perform tasks that are mandatory in accordance with the methodological guide;
- save the results obtained for further preparation of reports on the results of laboratory work.

Tasks and materials for quick checks/creative tasks are developed by the teacher based on the course material and submitted in Google Classroom or in another form.

Rules of conduct in class

When studying the material of the academic discipline "Fundamentals of Electronic Communications Networks," students listen attentively to the lecturer during lectures and, if necessary, write down important information, periodically complete express tests in written form (within 5–10 minutes) and modular tests (MT) using the Sikorsky platform. Dialogue between students and the teacher in the form of questions and answers is allowed.

During laboratory classes, students complete mandatory assignments. Student work involves participation in interactive forms of classroom organization (answering questions posed by the teacher or students). Each student is expected to be prepared for all questions related to the laboratory class, supplement the reports of other students, and express their own opinion during discussions of issues that arise during the completion of tasks. Students are allowed to use their own written notes and summaries. The use of laptops, tablets, and phones for educational purposes is permitted. At the same time, students should try to express their own opinions rather than read out other people's texts. The teacher critically analyzes the presentations, comments on mistakes, and moderates discussions between students.

The topics of lectures and laboratory classes are covered in the course syllabus, which is available on the Electronic Campus, the website of the Department of Radio Engineering, and the Sikorsky platform (Moodle, Google Classroom).

Bonus and penalty points

Bonus points. Students are encouraged to independently study topics that are not included as mandatory in the course of this subject (use of such technology when performing laboratory work +5 points maximum).

Student participation in solving problems that many students encounter when performing laboratory tasks is encouraged (+1 point for solving one problem).

Students are encouraged to create new teaching materials (new test questions, suggestions for improvement, etc.) and to find errors in existing teaching materials (+1 point for each suggestion/error found).

Missed tests

The result for a student who did not attend the assessment is zero. If a student misses an assessment for a valid reason, they are given the opportunity to complete it (do the lab work) in the presence of the instructor. If the absence was without a valid reason, the issue of making up the assessment is decided with the instructor in consultation 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 HCW 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, 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 behavior

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

8. Types of control and learning rating system for assessing outcomes (LRS)

Ongoing assessment

Current control is carried out during classes and aims to check the level of students' preparation for classes. During laboratory classes, students are surveyed on topics related to the subject. Modular control work is carried out once per semester to check residual knowledge of the most important section of the academic discipline. Express control in the form of tests is carried out after lectures.

Calendar control

Calendar control is carried out twice per semester as monitoring of the current status of syllabus requirements fulfillment. There are two possible results of calendar control: certified (c) and not certified (n/c). The result depends on the number of points scored at the time of calendar control in accordance with the requirements of Igor Sikorsky KPI.

Semester control

Semester control is considered a final test.

Assessment and control measures

A student's grade for a course consists of points earned for:

1) assessment of residual knowledge by completing express test tasks based on lecture materials using tests on the Sikorsky platform;

2) work in 6 laboratory classes;

3) a modular test

4) homework control work

Information on the above points, summarized in a table

No.	Assessment	Maximum score	Number	Total
1	Attendance at lectures (test after lecture)	2	9	15
2	Work in laboratory classes	10	6	60
3.	Modular test (MT)	5	1	5
4.	Home control work (HCW)	20	1	20
5.	Bonuses	10	1	10
6.	Credit (if you did not score 60)	40	1	40
	Total without bonuses			10
	Total with bonuses			11

In order to receive the highest rating, students must actively participate in laboratory classes, actively supplement the answers of other students, clearly and logically express their own position on discussion issues, and complete MT and express controls in a timely manner. Students are given a one-time opportunity to complete MT and express controls.

The following factors lead to a decrease in a student's rating: failure to complete MT and express controls; inadequate preparation for laboratory classes; inaccuracies, incompleteness, errors in answers, or reliance on unreliable sources.

The instructor evaluates the student's work at each laboratory class and enters the scores for the work and results of the MT and express controls into the "Current Control" module of the Electronic Campus. The results of the first and second calendar controls depend on the student's current rating and are entered by the instructor into the "Calendar Control" module of the Electronic Campus in the eighth and sixteenth weeks of study, respectively (see Appendix C).

The student may appeal the teacher's assessment by submitting a complaint to the teacher no later than the day after the student has been informed of the assessment given by the teacher. The complaint will be considered in accordance with the procedures established by the university.

Conditions for admission to semester control

A minimum score of 40 points, completion of the HCW with a grade of at least "sufficient".

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 discipline (educational component)

A recommended list of questions for semester assessment (test) is provided in Appendix A to the syllabus.

Recommendations for students

During lectures, students should write down key terms and concepts, note the main points of the topic being discussed, and summarize the generalizations and conclusions made by the instructor. This material will be useful when preparing for lab classes, MT, HCW, and quick tests.

When preparing for a laboratory class, students must study the lecture material on a specific topic and, preferably, familiarize themselves with additional resources on the Internet. If questions arise or unclear points are identified, they should be discussed with the teacher. During the lab session, each student should try to master the practical skills that can be mastered on their own. Students should not refuse to answer the instructor's questions. Even if a student does not know the answer, it is advisable to try to answer, express their opinion based on their own knowledge, experience, logic of the question, etc. However, it is important to remember that not knowing the subject matter is a significant shortcoming in a student's work and will negatively affect their overall grade. A responsible attitude toward preparing for each lab session allows students not only to properly master the material, but also to save effort when taking semester exams.

Students may be credited for a course topic if they have certificates of completion of distance or online courses on the relevant subject.

Distance learning

Synchronous and asynchronous distance learning is possible using video conferencing platforms (Google Meet, Zoom, etc.) and the Sikorsky distance learning educational platform (Moodle).

Inclusive learning

Inclusive learning is permitted.

Work program for the academic discipline (syllabus):
Compiled by: Senior Lecturer of the Department of RI, Serhii Mykolaiovych Litvintsev

Approved by: the Department of Radio Engineering (Minutes No. 06/2025 dated June 23, 2025).

Approved by: the RTF Methodological Council (Minutes No. 06/2025 dated 26.06.2025)

10. Appendix A

Semester control is carried out by means of a test. The test consists of answering three questions, which are included in the test ticket and approved at a meeting of the department. Two questions are theoretical, the third question is practical and requires the configuration of real equipment to provide a complete answer.

A sample test paper is provided below.

Sample test

NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE "

Level of higher education **First (bachelor's)**
(degree name)

Specialty ***172 Electronic Communications and Radio Engineering***
(code and name of the training program)

Educational program ***Intellectual technologies of radio-electronic engineering***
(code and name of specialty)

Academic discipline ***Fundamentals of Electronic Communications Networks***
(name)

TEST PAPER No. _____

1 *Questions from Block I*
2 *Questions from Block II*
3 *Task from Block III*

Approved at a meeting of the Department ***of Radio Engineering***
(name of department)

Minutes No. " " 202_

Head of the Department of Radio Engineering _____
(signature) (First name, last name)

The final test consists of two theoretical questions and one practical task, each of which is worth 20 points. In case of an ambiguous situation, an additional question in the form of a task may be added, which is worth 20 points.

Theoretical question

- complete answer (at least 90% of the required information) — 15–20 points;
- sufficiently complete answer (at least 75% of the required information or minor inaccuracies) — 9–14 points;
- incomplete answer (at least 60% and some errors) — 2–8 points;
- unsatisfactory answer — 0 points.

Practical task

The practical task requires the student to perform calculations, configure a real network with real network equipment, and verify its performance.

- a working network with all the necessary settings and calculations (at least 90% of the required information) — 15–20 points;
- a working network with partial settings and calculations (at least 75% of the required information or minor inaccuracies) — 9–14 points;

– partially working network with partial settings and calculations (at least 60% and some errors) — 2–8 points;
– non-functional network — 0 points.

Additional question

– correct answer — 19–20 points;
– correct solution with minor errors — 15–18 points;
– correct approach, incorrect answer — 10–14 points;
– incorrect solution — 0 points.

Questions for creating exam tickets

Questions from Block I

1. Describe TCP/IP stack
2. What does DNS address mean?
3. What is a MAC address?
4. What types of addressing exist in TCP/IP
5. What is OSI reference model
6. What is a subnet mask
7. Compare OSI and TCP/IP
8. What are the ways of assigning IP addresses
9. What are white and gray IP addresses
10. Explain the structure of a subnet

Questions from Block II

1. What is a switch
2. What is a router
3. Comparison of switch and router
4. Comparison of L2 and L3 switches
5. What is a patch cord, what types are there
6. When to use T-568A and when to use T-568B
7. How does an access point differ from a Wi-Fi router
8. Why is DNS service needed in a network
9. Why do you need a DHCP service on the network
10. What is VLAN technology used for

Tasks from Block III

1. Calculate and build a single-level network with the specified mask
2. Calculate and build a single-level network with the specified IP address
3. Calculate and build a single-tier network using an L2 switch
4. Calculate and build a single-tier network using an L3 switch
5. Calculate and build a single-tier network using a router
6. Calculate andbuild a single-level network based on Wi-Fi router

The total number of points is converted into a grade according to the table:

Semester or credit points	**Credit grade**
95–100	Excellent
85–94	Very good
75–84	good
65–74	satisfactory
60–64	sufficient
less than 60	unsatisfactory
Not counted HCW, not defended all laboratory work	Not admitted

11. Appendix B

MODULAR TEST (MT)
in the academic discipline
BASICS OF ELECTRONIC COMMUNICATIONS NETWORKS
first (bachelor's) level of higher education, bachelor's degree

Form of study ***full-time***

After completing the course of lectures, students are given a one-time opportunity to write an MCR, which consists of test tasks. The MT is graded on a 5-point scale.

Assignments for MT

The test tasks for the MT are formed from the following blocks:

1. Network design principles and elements
2. Network models
3. Addressing in TCP/IP
4. Network protocols
5. Management in computer networks
6. TCP/IP application layer
7. Wireless networks
8. Network diagnostics
9. TCP/IP in Windows and troubleshooting
10. Modern technologies and computer network security
11. Routing
12. Services using TCP/IP

12. Appendix C

LEARNING Rating System (LRS) FOR EVALUATING LEARNING OUTCOMES
from the academic discipline
BASICS OF ELECTRONIC COMMUNICATION NETWORKS
first (bachelor's) level of higher education, bachelor's degree

form of study ***full-time***

1. The student's grade for the academic discipline consists of points awarded for:
- assessment of residual knowledge in 9 lectures;
- work in 6 laboratory classes;
- modular test (MT);
- home control work (HCW).

Distribution of teaching time by type of class and assignment from the credit module according to the working curriculum:

Semester	Teaching time		Distribution of teaching hours			Control measures		
	ECTS credits	academic hours	Lectures, hour	Lab work, hour	Self-study (SS), hour	Modular test (MT), hour	HCW	Semester assessment
4	3	54	18	36	36	1	1	Final test

A student's credit module rating consists of points awarded for:
1) Passing tests after attending lectures — maximum number for 9 lectures, points — 15.
2) Completion and defense of 6 laboratory works, maximum number of points — 60.
3) Completing a module test (MT), maximum number of points — 5.
4) Completing and defending a home control work (HCW), maximum number of points — 20.
5) Bonus points — maximum number of points — 10.

Rating point system

1. Testing of knowledge level after each lecture

1.1. Testing is conducted immediately after the lecture. Testing time — 72 hours.
1.2. Testing is conducted by taking tests in the Moodle system on the Sikorskii platform (https://do.ipo.kpi.ua).
1.3. Questions in tests correspond to the topic of the lecture.
1.4. Weight of one question (correct answer) is 0.25 points.

2. Laboratory work

2.1. Completing homework on laboratory work — 1 point (availability of the homework file or its presence in the report when performing offline).
2.2. Completion of laboratory work.
— When performing the work in person: 3 points for all completed and working tasks. Screenshots in the report serve as confirmation of completion.
— When performing the work online: 1 point for one mandatory task (presence of a file for the task).
2.3. Defense of laboratory work (there is an option to defend through testing):

– full mastery of the material during defense (at least 90% of the required information) — 5 points;
– partial mastery of the material (at least 80%) — 4 points;
– partial mastery of the material (at least 70%) — 3 points;
– satisfactory mastery of the material (at least 60%) — 2 points;
– unsatisfactory mastery of the material (less than 60%) — 0 points;
Defense on the day of completion or at the next class — +1 point for one laboratory work (bonus).
The lab work is considered successfully defended if the student scores 6 out of 10 points. If the student scores less than 6 points, the work must be defended again.

3. Modular test (MT)

The MT is conducted after the completion of the lecture course by means of testing in the Moodle system.
For more details, see Appendix B. The maximum number of points is 5.

4. Home control work (HCW)

The HCW assessment consists of three parts:

- Calculations according to the assignment (max 10 points)
- HCW formatting (max 3 points)
- HCW defense (max 7 points) — there is an option to defend via testing
- Bonus (max 4 points)

Completion of HCW:
– the assignment for the final coursework corresponds to the module topic;
– The HCW is completed during the semester;
– the deadline for submitting the HCW for review is determined by the instructor;
– The date of submission of the HCW is considered to be the date when a hard copy of the HCW is handed over to the teacher, in which at least 90% of the assignment has been completed and the work has a finished appearance and format.

Compliance with assigned HCW task:
– complete and accurate solution of the assignment — 10 points;
– partial solution of the task — 8 points;
– incomplete solution of the task — 6 points;
– task not completed or does not correspond to the approved topic — 0 points.

Formatting and structure:
– full compliance with the requirements and the presence of all necessary structural elements — 3 points;
– formatting with minor violations or not all structural elements present — 2 points;
– formatting with violations, recommended structure violated, minor grammatical and stylistic errors — 1 point;
– No HCW or complete lack of structure, significant number of grammatical and stylistic errors — 0 points.

Originality of solution provided:
– the solution provided was not discussed in the lecture course and was not proposed in practical classes as a solution option — 4 points (bonus).

Defense of HCW:
– complete mastery of the material presented in the HCW, understanding of its essence — 7 points;
– partial mastery of the material (more than 75%) or incomplete understanding of the issues covered — 5 points;

– poor command of the material (more than 60%) or lack of understanding of the essence of the issues covered
— 3 points;

– unsatisfactory mastery of the material (less than 60%) and lack of understanding of the essence of the issues covered — 0 points.

The HCW is considered passed if it receives at least 12 points.

5. Bonus and penalty points

Penalty points (not taken into account during wartime):

– late submission of laboratory work — −1 point for each;

– late submission of final HCW for review — up to −10 points (−1 point for each day of delay).

Bonus points:

– timely defense of laboratory work — 1 point if the work is defended on the day of completion or at the next scheduled class;

– early submission of coursework for review — 2 points if the coursework is submitted for review one week before the deadline or earlier;

– original solution of the HCW;

– original solution of laboratory work, or solution of a task in addition to the one provided;

– proposed your own version of tests;

– proposed your own version of the coursework.

A student cannot receive more than 10 penalty points or 10 bonus points!

The maximum number of points is 100. Completion of coursework and defense of all laboratory work is a prerequisite for admission to the exam!

Students who have earned more than 60 points during the semester are entitled to receive an "automatically"; points are converted into grades according to the table.

Students who have not earned 40 points during the semester are considered to have failed to complete the course load and are not allowed to take the exam.

Students who have earned less than 60 points but more than 40, as well as those who want to improve their grade, take the exam. In this case, points for passing the exam are added to the HCW points, and this rating is final, i.e., during the exam, it is possible to earn fewer points than before.