TELEMEDICINE AND COMPUTER NETWORKS
Syllabus of the academic discipline (Syllabus)

Academic discipline requirements	
Level of higher education	First (bachelor's)
Branch of knowledge	16 Chemical and Bioengineering
Specialty	163 Biomedical Engineering
Educational program	Medical Engineering
Discipline status	Selective
Form of study	Full-time (daytime) / blended / distance learning
Year of training, semester	3d year, fall semester
Scope of the discipline	4 ECTS credit modules (120 hours)
Semester control/control measures	Credit, MCR, essay
Class schedule	According to the schedule on the website http://rozklad.kpi.ua/
Language of instruction	Ukrainian / English
Information about the course leader/teachers	**_Lecturer_**: PhD, Associate Professor, Rudnitska Olena, e-mail – olena.rudnitska@gmail.com, Telegram -@ROlenaV. **_Practical_**: PhD, Associate Professor, Rudnitska Olena, e-mail – olena.rudnitska@gmail.com, Telegram -@ROlenaV.
Course placement	https://classroom.google.com/c/NjE4OT kwNTIwMTYx?cjc=hva423u

Academic discipline program

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

The main goal of the academic discipline "Telemedicine and Computer Networks" is to develop in students the ability to use methods and tools of computer systems for building computer networks and designing medical complexes and systems, to apply a modern component base of circuit engineering for developing local computer networks and solving problems related, in accordance with the specialization of the faculty, to the development and engineering maintenance of computer networks and systems for biomedical purposes.

Teaching in the discipline "Telemedicine and Computer Networks" is carried out on the basis of a student-centered approach and a strategy of interaction between the teacher and the student in order for students to master the material and develop their practical skills.

According to the educational and professional programs (EPP) of the first "bachelor's" level of higher education, after studying the discipline, students can acquire (strengthen) the following competencies.

General competencies:

GC 01 - Ability to apply knowledge in practical situations (strengthening).
3K 02 - Knowledge and understanding of the subject area and understanding of professional activities (strengthening).
3K 06 - Ability to search, process, and analyze information from various sources (strengthening).
3K 07 - Ability to generate new ideas (creativity) (strengthening).
3K 08 - Ability to make informed decisions (strengthening).

Special (professional) competencies:
PC 01 - Ability to use engineering software packages for conducting research, analyzing, processing and presenting results, as well as for automated design of medical devices and systems (amplification).
PC 03 - Ability to learn and apply new methods and tools for analysis, modeling, design, and optimization of medical devices and systems (enhancement).
PC 06 - Ability to effectively use tools and methods for analysis, design, calculation, and testing in the development of biomedical products and services (strengthening).

Ability: to apply methods and tools of computer systems to build computer networks and design medical complexes and systems, to solve problems related, in accordance with the specialization of the faculty, to the development and engineering maintenance of computer networks and systems for biomedical purposes.

According to the EPP, as a result of mastering the academic discipline, students must demonstrate the following program learning outcomes

PLO 5 - Be able to use databases, mathematical and software for data processing and computer modeling of biotechnical systems (amplification).

PLO 08 Understand theoretical and practical approaches to the creation and management of medical equipment and medical technology (amplification).

PLO 12 Provide recommendations for selecting equipment to facilitate diagnosis and treatment (amplification).

Be able to apply the acquired knowledge in professional activities during the development, setup and operation of information systems; develop the architecture of telecommunication networks for the needs of telemedicine based on the optimal use of modern technologies; make basic settings for telemedicine networks and relevant software.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of study according to the relevant educational program)
The academic discipline "Telemedicine and Computer Networks" is included in the list of elective disciplines and has an interdisciplinary nature. It integrates, in accordance with its subject, knowledge from other academic disciplines: Fundamentals of Computer Science and Object-Oriented Programming. According to the structural and logical scheme of the specialist training program, the discipline "Telemedicine and Computer Networks" is closely related to other disciplines of professional training: Laboratory Analytical Techniques, Modern Optoelectronic Diagnostic Devices.

3. Content of the academic discipline

The main topics covered in the course:

Section 1. General principles of building computer networks.
Topic 1.1. Modern network technologies and development trends. Basic concepts and definitions.
Topic 1.2. Structure of telemedical systems. Means and standards of information transmission in telemedicine
Topic 1.3. Basic principles of building networks.
Topic 1.4. Models, types, topologies of networks.

Section 2. Local, regional, global networks
Topic 2.1. Network components: cables, network adapters, switches and hubs
Topic 2.2. Number systems and their application in networks.
Topic 2.3. Network addressing. Fundamentals of IPv4 and IPv6
Topic 2.4. Local networks. Data transmission in local networks
Topic 2.5. Global networks and regional networks. Structure, addressing, routing.
Topic 2.6. Designing a home network. Structure and basic approaches
Topic 2.7. Providing network services. Network protocols. Client-server interaction.

Section 3. Configuring and maintaining networks
Topic 3.1. Network operating systems. Basic tools and commands.
Topic 3.2. Configuring network devices.
Topic 3.3. Network security. Firewalls and firewalls.
Topic 3.4. Testing, troubleshooting, and troubleshooting approaches.

4. Educational materials and resources
Basic literature

1. Shashi Gogia. Fundamentals of Telemedicine and Telehealth. Academic Press/
ISBN: *978-0-12-814309-4,* **DOI:** *10.1016/C2017-0-01090-X*

2. Коробейнікова Т.І. Комп'ютерні мережі. / Коробейнікова Т.І., Захарченко С.М. – Львів: Львівська політехніка, 2022. – 228с.

3. Кулаков Ю. О. Комп'ютерні мережі : підручник. / Ю. О. Кулаков, Г. М. Луцький. / за ред. Ю. С.Ковтанюка. – К. : Видавництво „Юніор", 2005. – 400 с.

4. Буров Є. Комп'ютерні мережі. [2-е вид., оновл. і допов.] / Буров Є. Львів : БаК, 2003. 584 с.

Additional literature

1. Олексюк В., Балик Н., Балик А. Організація комп'ютерної локальної мережі.– Тернопіль: Підручники і посібники, 2006. – 80 с. http://programming.in.ua/other-files/internet/38-organizacija-lokal-lan.html

Information resources

1. Law of the Ministry of Health "On Telemedicine"https://moz.gov.ua/uk/decrees/nakaz-moz-ukraini-vid-17092022--1695-pro-zatverdzhennja-porjadku-nadannja-medichnoi-dopomogi-iz-zastosuvannjam-telemedicini-reabilitacijnoi-dopomogi-iz-zastosuvannjam-telereabilitacii-na-period-dii-voennogo-stanu-v-ukraini-abo-okremih-ii-miscevostjah

2. 2. Cisco Academy Course "CCNA: Introduction to Networking"

https://www.netacad.com/courses/networking/ccna-introduction-networks

3. 3. Cisco Academy Course "Networking Essentials"

https://www.netacad.com/courses/networking/networking-essentials

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

№ з/п	Тема	Program Learning Outcomes	Основні завдання	
			Practical classes	*Deadline*
1.	Modern network technologies and development trends. Basic concepts and definitions..	PLO 05, PLO 08	-	1-й week
2.	Structure of telemedical systems. Means and standards of information transmission in telemedicine	PLO 05, PLO 08	PC 1.	2-й week
3.	Basic principles of network construction.	PLO 08	-	3-й week
4.	Models, types, network topologies.	PLO 08, PLO 12	PC 2.	4-й week
5.	Network components: cables, network adapters, switches and hubs	PLO 05	PC 3.	5-6-й week
6.	Numbering systems and their application in networks.	PLO 08, PLO 12	PC 4.	7-й week
7.	Network addressing. Fundamentals of IPv4 and IPv6	PLO 08, PLO 12	PC 5.	8-й week
8.	Local area networks. Data transmission in local area networks	PLO 08, PLO 12	PC 6.	9-й week
9.	Global networks and regional networks. Structure, addressing, routing.	PLO 08, PLO 12	PC 7.	10-й week
10.	Designing a home network. Structure and basic approaches	PLO 08, PLO 12	PC 8.	11-й week
11.	Providing network services. Network protocols. Client-server interaction.	PLO 08, PLO 12	PC 9.	12-й week
12.	Network operating systems. Basic tools and commands.	PLO 08, PLO 12	PC 10.	13-й week
13.	Configuring network devices.			14-й week
14.	Network security. Firewalls and firewalls			15-й week

Practical classes
The purpose of the practical classes is to master the skills and abilities for designing, building and configuring telemedical networks.

Practical work 1. Packet Tracer skills. Creating a local network.
Practical work 2. Checking NAT conversion on a wireless router.
Practical work 3. Connecting to a web server. Configuring DHCP on a wireless router.
Practical work 4. Connecting a switch via the console port
Practical work 5. Configuring basic wireless network security functions
Practical work 6. Client-server technology. Interaction with the client, studying web requests
Practical work 7. Navigating through IOS, Using the show Cisco IOS commands, and the ipconfig and ping commands
Practical work 8. Configuring the router's default parameters. Configuring the ssh protocol
Practical work 9. Troubleshooting wireless connections
Practical work 10. Configuring and verifying simplified network settings.

The Cisco Packet Tracer network environment emulation software tool is used to perform laboratory work

6.   Student's independent work (SIW)

One of the main types of semester control during the mastering of the academic discipline "Telemedicine and Computer Networks" is the execution of an essay. The essay is performed in accordance with the requirements, within the time specified by the teacher.

The main goal of the essay is to solve a practical problem using the theoretical material learned in lectures and independently, and practical skills obtained in practical work. The student can write an essay only on a topic agreed with the teacher.

Approximate topics of the essay:
1. Analysis of the work and optimization of computer networks.
2. Architecture of the network system, ISO / OSI model.
3. Virtual local computer networks: purpose, means of formation, organization of functioning, evaluation.
4. Classification of computer networks. Protocols, services, local and global networks.
5. Integrated approach to building an antivirus protection system.
6. TCP / IP architecture.
7. Internetwork layer of TCP / IP architecture and IP protocol.

The assay includes: title page, introduction, table of contents, main part, conclusions, list of sources used.

The title page of the abstract should contain the following information: name of the university; name of the faculty; name of the department; name of the academic discipline; name of the test; level of higher education; code and name of the specialty; name of the educational and professional program; option of the task, surname and name of the student, course, academic group number; full name of the supervisor; result of the defense; year.

The introduction should substantiate the relevance and practical significance of the topic of the abstract, and define the goal and objectives of the work.

The main part - the topic of the abstract is revealed by highlighting the main issues, the presentation should be clear, specific, accompanied by necessary explanations with references to sources of information.

References should be indicated by a serial number according to the list of sources used in square brackets, for example, "... in the collection of tasks [3, p.34] ...".

The conclusion indicates the experience gained in completing the essay task.

The list of sources used (at least 10 sources) is drawn up in accordance with current regulations.

If the information is taken from the Internet, it is necessary, as for ordinary literature, to indicate the author, the title of the article, and then provide the address of the website on the Internet.

The total volume of the essay can vary from 15 to 25 pages of the main text, which depends on the student's ability to briefly and at the same time comprehensively reveal the topic.

The essay is evaluated according to the following criteria: completeness and depth of disclosure of the topic; possession of theoretical material; availability of illustrations (diagrams, tables, figures, schemes, etc.); clarity of references to sources of information; quality of the essay design; substantiation of the student's own opinion in the form of a conclusion.

The deadline for submitting the essay for review: 10 days before the start of the exam session.

The abstract is not checked for plagiarism, but must meet the requirements of academic

integrity. If academic dishonesty is detected, the work is canceled and not checked.

No.	Types of independent work	Number hours
1	Preparation for lectures and practical classes	10
2	Completion of tasks on the topic of practical classes	27
3	Preparation for the modular test	2
4	Writing an essay	15
5	Test	6
Together		**60**

7.   Academic discipline policy (educational component)

Attendance at classes

Attendance at lectures is not mandatory. Attendance at practical classes and laboratory classes is desirable, since they include writing express control papers / test tasks, and also defense of practical works, laboratory works.

The assessment system is focused on obtaining points for student activity, as well as completing tasks that are capable of developing practical skills and abilities.

Missed control measures

Missed control measures (defense of practical works, laboratory works) must be worked out in the following classes, provided that the task planned for the current class is completed, or in consultations.

Missed writing of a modular control paper and express control tests are not worked out.

An essay submitted for review after the deadline is evaluated with a decrease in the number of weight points.

Incentive points

Incentive points	
Criterion	Weighted score
Improving practical or laboratory work	+1 point (for each practical work)
Taking distance learning courses on topics agreed with teachers	+5 points
Preparing a scientific paper to participate in a student scientific paper competition	+10 points
Writing theses, articles, participating in international, all-Ukrainian and/or other events or competitions on the subject of the academic discipline	+5 points

However, according to the provisions of https://osvita.kpi.ua/node/37, clause 2.7, the amount of incentive points cannot exceed 10% of the rating

scale.

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". More details: https://kpi.ua/code .

Norms of ethical behavior

The norms of ethical behavior of 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". More information: https://kpi.ua/code.

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the examination procedure and expect it to be addressed according to predetermined procedures.

The student has the right to appeal the results of the control measure in accordance with the approved regulations on appeals at Igor Sikorsky Kyiv Polytechnic Institute (approved by order No. HOH/128/2021 dated 05/20/2021) - https://osvita.kpi.ua/index.php/node/182

Inclusive learning

The academic discipline " Web Technologies and Web Design " can be taught to most students with special educational needs, except for students with severe visual impairments that prevent them from completing tasks using personal computers, laptops, and/or other technical means.

Distance learning

Distance learning takes place through the Sikorsky Distance Learning Platform.

Distance learning through additional online courses on a specific topic is permitted subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material through such courses is permitted, but students must complete all tasks provided for in the academic discipline.

The list of courses is offered by the teacher after students express their desire (since the bank of available courses is updated almost every month).

The student provides a document confirming completion of the distance learning course (in the case of completing the full course) or provides completed practical tasks from the distance learning course and, subject to passing an oral interview with the teacher on the topics covered, may receive grades for the control measures provided for the subjects studied.

Practical classes, as well as individual assignments, are carried out during independent work of students in remote mode (with the possibility of consulting with the teacher via email and social networks).

Learning in a foreign language

Teaching in English is provided only for foreign students.

At the request of students, it is allowed to study the material using English-language online courses on topics that correspond to the topics of specific classes.

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

Current control: carried out during classes and aims to check the level of students' preparation for classes and the current implementation of the curriculum. During practical classes, reports on PC are completed and defended. It is also provided for the implementation of modular control work and individual assignments.

Evaluation and control measures

Control measures evaluation system:

	Control measure	%	Gravimetric mark	Number	Total
.	Practical classes (PC)	50	5	10	50
.	Express control work / test tasks	12	3	4	12
.	Modular control work	18	18	1	18
.	Essay	20	20	1	20
.	Credit work[1]	80	80	1	80
Total					100

[1] *It is taken into account in the total rating together with the grade for the essay if the student did not score 60 points for the semester or he wants to improve his grade..*

Calendar control (CC) - *Not conducted for 4th year students.*

In order to receive the highest rating, the student must: timely and qualitatively complete, prepare and defend PC reports and an abstract, and accordingly complete the MCR.
A student may appeal a teacher's grade by submitting a complaint to the teacher no later than the day after the student is informed of the grade. The complaint will be considered according to the procedures established by the university.

Conditions for admission to semester control: having at least 40 points and completing the MCR, as well as completing and defending all reports on the PC and the essay with a score of no less than "sufficient".

A student receives a credit without additional tests if the sum of the points scored is not less than 60. A student who received more than 60 points in the semester, but wishes to improve his/her result, can take part in a credit test or a survey on questions before the credit. In this case, the final result consists of the points received in the credit test or during the survey.
Applicants who have met all the admission requirements and have a rating score of less than 60 points take a credit test (CT). The final result consists of the points obtained in the credit test and the defense of the essay.
The final test is conducted at the final session.
The credit test is evaluated out of 100 points and is determined as the sum of the points for the credit test and the points for the individual semester assignment (essay). In this case, the size of the credit test evaluation scale is reduced by the maximum value of the points provided for the essay (15 points). https://osvita.kpi.ua/node/37 (p.3.12)

Criterion			First CC	Second CC
Calendar control period			8th week	14th week
Conditions for obtaining	Current rating		≥ 15 points	≥ 40 points
	Performing practical work	PC №1-4	+	+
		HC №5-	-	+

a positive result from calendar control		10		
	Express control work / test tasks	№1-2	+	+
		№3-4	-	+
	Modular control work (MCW)	Evaluated MCW	-	+
	Essey	Evaluated Essey	-	-

In case of academic dishonesty during studies, the test will not be counted.

The results are announced to each student individually in person or remotely (by e-mail). They are also recorded in the "Electronic Campus" system

Optional admission requirements:
1. Activity in practical classes.
2. Activity in laboratory classes.
3. Positive result of the first certification and the second certification.
4. Attendance at lectures.

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

Number of points	Rating
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Enough
Less than 60	Unsatisfactorily
Admission conditions not met	Not allowed

Additional information on the discipline (educational component)

A list of questions for preparing for the module test, as well as for preparing for the exam, is provided in Appendix 2.

Scientific and pedagogical workers can make clarifications to the content modules, RSA and tasks for the practical classes, MCW and essay, taking into account their own methodological developments and the surrounding situation.

Distance learning through additional online courses on a specific topic is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material using such courses is allowed, but students must complete all the tasks provided for in the academic discipline. The list of courses is offered by the teacher after students express their desire (since the bank of available courses is updated almost monthly). The student provides a document confirming completion of the distance course (in the case of completing the full course) or provides completed practical tasks from the distance course and, subject to an oral interview with the teacher on the topics covered, can receive grades for the control measures provided for the topics studied.

The working program of the academic discipline (syllabus):

Compiled by: PhD, Associate Professor Rudnitska Olena

Approved by the Department of Biomedical Engineering (Minutes No. 16 dated 06/21/2024);
Approved by the Methodological Commission of the Faculty (Minutes No. 9 dated 06/26/2024)

List of questions for preparing for the module test, as well as for preparing for the exam

1. Explain the concept of a computer network.
2. Explain the concepts of: subscriber, server, client.
3. Classification of a network by bandwidth, by size.
4. Classification of a network by the ratio of nodes and by access.
5. Classification of a network by channel bandwidth and by commonality of OS.
6. Purpose of the network.
7. Architecture of a computer network
8. The concept of topology.
9. Networks with ring topology (description, advantages, disadvantages).
10. Star topology (description, advantages, disadvantages).
11. Bus topology (description, advantages, disadvantages).
12. The concept of protocols and interfaces.
13. Wired communication lines
14. Coaxial cable
15. Twisted pair
16. Fiber optic cable
17. Wireless communication channels
18. Repeaters
19. Hubs
20. Bridges
21. Switch
22. Router
23. Explain the concepts of protocol, interface, communication protocol stack
24. OSI model layers: application, presentation, session.
25. Transport layer of the OSI model
26. Network layer of the OSI model
27. Channel and physical layers of the OSI model
28. Connection-oriented protocols, connection-less protocols.
29. Network-dependent and network-independent layers
30. IEEE 802.X CATEGORY STANDARDS
31. MAC and LLC layers
32. Types of LLC layer procedures
33. OSI stack
34. TCP/IP stack
35. IPX/SPX stack
36. NetBIOS/SMB stack
37. Application layer of the TCP/IP stack
38. Main (transport) layer of the TCP/IP stack
39. Internetwork layer of the TCP/IP stack
40. Network interface layer of the TCP/IP stack
41. Types of TCP/IP stack addresses
42. IP address classes
43. Special IP addresses
44. Using masks in IP addressing
45. DNS domain name system
46. Features of Fast Ethernet technology
47. Differences between Fast Ethernet technology and Ethernet technology
48. General characteristics of the Gigabit Ethernet standard
49. What is common in Gigabit Ethernet technology compared to Ethernet and Fast Ethernet technologies?
50. How does 100VG-AnyLAN differ from classic Ethernet
51. Wireless communication technologies
52. What is routing?

53. Define the concept of static routing.

54. Specify the features of static routing.

55. List the advantages of static routing.

56. What are the disadvantages of static routing?

57. Specify the algorithm for configuring static routing in a network.

58. What commands are needed to configure static routing?

59. Name the purpose of the IP address and subnet mask.

60. What is a DNS server?

61. Specify the purpose of NAT technology.

62. What are the modes of operation of NAT?

63. List the commands that must be used when configuring NAT in static mode.

64. Specify the commands that must be used when configuring NAT in overload mode.

65. List the advantages of NAT technology.

66. Name the features of the RIP protocol.

67. List the disadvantages and advantages of the RIP protocol.

68. Name the commands used when configuring the RIP protocol.

69. List the features of the OSPF protocol.

70. List the algorithm for the OSPF protocol.

71. Compare the RIP and OSPF protocols, what are the disadvantages and advantages of each of them?

72. List the commands used to configure the OSPF dynamic routing protocol.

73. How do link-state protocols differ from distance-vector protocols?

74. List the features of the EIGRP protocol.

75. How is the EIGRP route metric calculated?

76. List the algorithm for the EIGRP protocol.

77. Compare the EIGRP and OSPF protocols, what are the advantages and disadvantages of each of them?

78. Specify the commands used to configure the EIGRP dynamic routing protocol.

79. What is a virtual computer network?

80. Specify the advantages of using local virtual computer networks.

81. What type of devices perform most of the work when using VLAN technology?

82. List the commands necessary to create a virtual computer network.

83. Specify what parameters can be used to group end devices into logical computer networks?

84. Why are access and trunk links used? What is the difference between them?