National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department
biomedical engineering

Telemedicine and Computer Networks

Working program of basic discipline (Syllabus)

Requisites for basic discipline	
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 discipline*
Form of study	*full-time (day) / mixed / remote*
Year of preparation, semester	*3 course (autumn semester)*
The scope of discipline	*4 ECTS credits / 120 hours*
Semester control / Control measures	*Test Work, Modular Test Work, Abstract*
Lessons schedule	*According to the schedule on the site http://rozklad.kpi.ua/*
Language of instruction	*English*
Information about course leader / teachers	***Lecturer:*** *Senior Lecture of BME Department Valentyna Danilova, e-mail – valnaa@ukr.net, Telegram - https://t.me/danilova_valentyna.* ***Practical:*** *Senior Lecture of BME Department Valentyna Danilova, e-mail – valnaa@ukr.net, Telegram - https://t.me/danilova_valentyna.*
Course placement	*Platform «Moodle» - Telemedicine and Computer Networks*

Curriculum of the discipline

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

The main purpose of the discipline "Telemedicine and Computer Networks" is the formation of students' ability to use methods and tools of computer systems for the construction of computer networks and design of medical complexes and systems, to apply a modern component base of circuitry for the development of local computer networks and solving related problems in accordance with the specialization of the faculty, with the development and engineering maintenance of computer networks and biomedical systems.

Since the discipline is selective, its study requires:

- *skills: knowledge of object-oriented programming methods; work with software; work with the Cisco Packet Tracer computer network emulator.*
- *competences: to apply methods and means of computer systems for construction of computer networks and design of medical complexes and systems, the decision of the problems connected, according to specialization of faculty, with development and engineering service of computer networks and systems biomedical purpose.*

General competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

GC 1 *- Ability to apply knowledge in practical situations.*
GC 2 *- Knowledge and understanding of the subject area and understanding of professional activity.*
GC 6 *- Ability to search, process and analyze information from various sources.*
GC 7 *- Ability to generate new ideas (creativity).*
GC 8 *- Ability to make well-grounded decisions.*

Special (professional) competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

> ***PC 1*** *- Ability to use engineering software packages for research, analysis, processing and presentation of results, as well as for automated design of medical devices and systems.*
> ***PC 3*** *- Ability to study and apply new methods and tools for analysis, modeling, design and optimization of medical devices and systems.*
> ***PC 6*** *- Ability to effectively use tools and methods for analysis, design, calculation and testing in the development of biomedical products and services.*

The program learning outcomes *after studying the discipline "Telemedicine and Computer Networks" are (OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

> ***PLO 6*** *- Knowledge of object research methods, analysis and processing of experimental data.*
> ***PLO 16*** *- Application of modern programming technologies and tools that support their use.*
> ***PLO 35*** *- Ability to provide advice on the choice of equipment to support diagnosis and treatment.*

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

The discipline "Telemedicine and Computer Networks" belongs to the cycle of professional training and has an interdisciplinary nature. It integrates according to its subject knowledge from other disciplines: Fundamentals of Computer Science and Object-Oriented Programming. According to the structural and logical scheme of the training program, the discipline "Telemedicine and Computer Networks" is closely related to other disciplines of training and is the basis for further practical work in the specialty.

3. The content of the discipline

The main sections and topics that will be considered in the process of studying the course:

Section 1. General principles of construction of computer networks.

Topic 1.1. The concept of an open system. Problems of standardization. OSI model and its levels. Standard stacks of communication protocols OSI, TCP / IP.

Topic 1.2. Local and global LANs. Requirements for modern computer networks.

Section 2. Local area networks (LANs).

Topic 2.1. General characteristics of LAN. Classification of LAN. Peer-to-peer and centralized networks. LAN topology.

Topic 2.2. Network adapter and hubs.

Topic 2.3. Interaction of LM software.

Topic 2.4. Reliability and safety of LM: characteristics of the reasons influencing the reliability of LM.

Topic 2.5. LAN technologies: Ethernet, TokinRing, Arcnet, FDDI

Section 3. Global and regional networks.

Topic 3.1. Methods of switching and routing information in large networks: channel switching, packet switching.

Topic 3.2. Network layer as a means of building large networks: principles of network integration based on network layer protocols.

Topic 3.3. Principles of routing. Routing protocols. Functional diagram of the router.

Topic 3.4. Implementation of interconnection by means of TCP / IP.

Topic 3.5. Addressing in IP networks.

Topic 3.6. The main characteristics of routers and hubs.

Topic 3.7. Characteristics of physical environments.

Section 4. Protection of information in networks

Topic 4.1. Technical means of network security.

Topic 4.2. Fundamentals of firewall technology.

4. Training materials and resources

Basic literature:

1.Олифер В. Г. Компьютерные сети. Принципы, технологии, протоколы : учебник для вузов. [4-е изд.] / В. Г. Олифер, Н. А. Олифер – СПб. : Питер, 2010. – 944 с.

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

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

4. Рональд Бодчер. Программа сетевой академии Cisco CCNA [3-е изд.] : [пер. с англ.] / Рональд Бодчер, К. Р. Киркендаль. – М. : изд. Дом "Вильямс", 2005. – 1186 с.

5. Рональд Бодчер. Программа сетевой академии Cisco CCNA 3 и 4. [3-е изд.] : [пер. с англ.] / Рональд Бодчер, К. Р. Киркендаль. – М. : изд. Дом "Вильямс", 2007. – 944 с.

6. Таненбаум Э. Компьютерные сети. [4-е изд.] : [пер. с англ.] / Таненбаум Э. СПб. : Питер, 2003. – 992 с.

7. Столлингс В. Компьютерные системы передачи данных. [7-е изд.] : [пер. с англ.] / Столлингс В. – М. : изд. дом "Вильямс", 2003. – 720 с.

8. Спортук М. Компьютерные сети и сетевые технологии. / М. Спортук, Ф. Папас – ООО „ТИД ДС", 2002. – 736 с.

9. Шиндер Д. Основы компьютерных сетей : [пер. с англ.] / Шиндер Д. – М. : изд. дом "Вильямс", 2002. – 656 с.

10. Кульгин М. В. Компьютерные сети. Практика построения. Для профе-ссионалов. [2-е изд.] / Кульгин М. В. – СПб. : Питер, 2003. – 462 с.

11. Столлингс В. Современные компьютерные сети. [2-е изд.] / Столлингс В. – СПб. : Питер, 2003. – 783 с.

12. Закер К. Компьютерные сети. Модернизация и поиск неисправностей / Закер К. : [пер. с англ.] – СПб. : Питер, 2003. – 1008 с.

13. Камер Д. Компьютерные сети и Internet. Разработка приложений для Internet / Камер Д. : пер. с англ. – М. : изд. дом "Вильямс", 2002. – 640 с.

14. Кларк К. Принципы коммутации в локальних сетях CISCO / К. Кларк, К. Гамильтон : [пер. с англ.] – М. : изд. дом "Вильямс", 2003. – 976 с.

15. Пакет К. Создание масштабируемых сетей CISCO / К. Пакет, Д. Тир : [пер. с англ.] – М.: Изд. дом "Вильямс", 2002. – 792 с.

16. Хилл Б. Полный справочник по CISCO / Хилл Б. : [пер. с англ.] – М. : изд. дом "Вильямс", 2004. – 1088 с.

17.Кучинский В. Ф. Сетевые технологии обработки информации: Учеб. пособие / В. Ф. Кучинский. – СПб: Университет ИТМО, 2015. – 115 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

Educational content

5. Methods of mastering the discipline (educational component)

№ s/n	Subject	Program learning outcomes	The main tasks	
			Control measure	Deadline
Spring semester, 4 ECTS credits / 120 hours				
1.	Local and global networks. OSI model and its levels.	PLO 6	-	1st week
2.	General characteristics of local networks. Classification of local networks. Topology of local networks. Peer-to-peer and centralized networks.	PLO 6	Laboratory work 1	2nd week
3.	Network adapter and hubs.	PLO 6	Practical work 1	3th week
4.	Interaction of local network software.	PLO 6 PLO 16	Laboratory work 2	4th week
5.	Reliability and security of local networks: Reliability and security of local networks: a description of the reasons that affect the reliability of local networks.	PLO 6 PLO 16	Practical work 2	5th week
6.	Local area network technologies: Ethernet, Tokin Ring, Arcnet, FDDI.	PLO 6 PLO 16	Practical work 3 Laboratory work 3	6th week
7.	Characteristics of physical environments	PLO 6 PLO 16	Practical work 4	7th week
8.	Methods of switching and routing information in large networks.	PLO 6 PLO 16	Laboratory work 4	8th week
9.	Principles of routing. Routing protocols.	PLO 6 PLO 16	Practical work 5	9th week
10.	Principles of network integration based on network layer protocols.	PLO 6 PLO 16	Laboratory work 5	10th week
11.	Principles of routing. Routing protocols.	PLO 6 PLO 16 PLO 35	Practical work 6	11th week
12.	Implementation of interconnection by means of TCP / IP.	PLO 6 PLO 16	Laboratory work 6	12th week
13.	Addressing in IP networks.	PLO 6 PLO 16	Practical work 7 Laboratory work 7	13th week
14.	Technical means of network security.	PLO 6 PLO 16	Laboratory work 8	14th week
15.	Fundamentals of firewall technology.	PLO 6 PLO 16	Laboratory work 9	15th week
16.	Modular control work	PLO 6 PLO 16 PLO 35	MCW	16th week
17.	Abstract	PLO 6 PLO 16 PLO 35	Registration and submission of work	17th week
18.	Test	PLO 6 PLO 16 PLO 35	Test	18th week

6. Independent student work

One of the main types of semester control during the mastering of the discipline "Telemedicine and Computer Networks" is the implementation of Abstract. Abstract is performed in accordance with the requirements, within the period specified by the teacher.

The main purpose of Abstract is to solve a practical problem using the material learned in lectures and independently, and practical skills acquired in practical work. The student can write Abstract only on the subject agreed with the teacher.

Approximate subject of abstract:

1. Analysis of work and optimization of computer networks.
2. Network system architecture, 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 wide area networks.
5. A comprehensive approach to building an antivirus protection system.
6. TCP / IP architecture.
7. Network layer architecture TCP / IP and IP protocol.

The title page of the Abstract should have the following content: the name of the university; name of the faculty; name of department; name of specialty, name of educational-professional program, name of academic discipline; theme Abstract; surname and name of the student, course, number of the academic group, year.

The title page is followed by a detailed plan (content) of the Abstract, which should highlight the introduction, sections of the main content (main topics studied), their subdivisions (if necessary), conclusion, list of sources used. The table of contents on the right indicates the page numbers at the beginning of each question. Each section begins on a new page.

The total amount of Abstract, depending on the chosen topic can vary from 15 to 25 pages of the main text (in consultation with the teacher).

Mandatory requirement: clear reference to sources of information. All figures, facts, opinions of scientists, quotations, formulas should have a reference in the form [2, p. 54] (the first digit means the number of the source in the list of references given at the end of the creative work, and the second digit - the page number in this source). It is desirable to use tables, diagrams, graphs, charts, etc. The list of used sources (not less than 10 sources) is made out according to operating rules. If the information is taken from the Internet, you need, as for ordinary literature, specify the author, the title of the article, and then provide the address of the site on the Internet.

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

Deadline for submission of Abstract for verification: 10 days before the test session.

Abstract is not tested for plagiarism, but must meet the requirements of academic integrity. In case of academic dishonesty, the work is canceled and not checked.

Policy and control

7. Policy of academic discipline (educational component)

Attending classes

Attendance at lectures is not mandatory, but it is desirable, because there are no sources that cover the systematized educational material in sufficient to master the credit module and to perform

Abstract. It is desirable to attend practical classes, because they discuss the material needed for practical work.

The grading system is focused on obtaining points for student activity, as well as performing tasks that are able to develop practical skills and abilities.

Control measures missed

Missed control measures (defense of practical work) must be practiced in the next classes, provided that the task is scheduled for the current lesson, or in consultations.

Omissions of writing a module test and express test are not fulfilled.

Abstract, which is submitted for inspection in violation of the deadline is evaluated with a decrease in the number of weight points.

Violation of deadlines and incentive points

Encouragement points		*Penalty points **	
Criterion	*Weight points*	*Criterion*	*Weight points*
Improving practical work or laboratory work	*1 points (for each practical work)*	*Untimely implementation and test of practical work*	*From -0.5 points to -1.5 points (depending on the delivery date)*
Passing distance courses on topics that are agreed with teachers	*5 points*	*Untimely implementation and test of laboratory work*	*From -0.5 points to -2.5 points (depending on the delivery date)*
Registration of scientific work for participation in the competition of student scientific works	*10 points*	*Untimely execution and test of Abstract*	*From -2 points to -16 points (depending on the construction period)*
Writing abstracts, articles, participation in international, national and / or other events or competitions on the subject of the discipline	*5 points*		

** if the control measure was missed for a good reason (illness, which is confirmed by a certificate of the established sample) - penalty points are not accrued.*

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". Read more: https://kpi.ua/code.

Norms of ethical behavior

Normative principles of behavior of students and employees, defined in sections 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code.

Procedure for appealing the results of control measures

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

The student has the right to appeal the results of the control measure according to the approved

provision on appeals in the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (approved by the order №NON/128/2021 from 20.05.2021) - https://osvita.kpi.ua/index.php/node/182

Inclusive education

The discipline "Telemedicine and Computer Networks" can be taught to most students with special educational needs, except for students with severe visual impairments who do not allow to perform tasks using personal computers, laptops and / or other technical means.

Distance learning

Distance learning takes place through the Sikorsky Distance learning Platform «Sikorsky».

Distance learning through additional online courses on certain topics 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 with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Performance of practical works, and also performance of abstract is carried out during independent work of students in a remote mode (with a possibility of consultation with the teacher through e-mail, social networks).

Learning a foreign language

Teaching in English is carried out only for foreign students.

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

8. Monitor and evaluate the system of evaluation of learning outcomes (Rating System of Evaluation)

Evaluation system (current control):

Autumn semester, 4 ECTS credits / 120 hours

№ s/n	Control measure	%	Weight points	Number	Total
1.	Execution and test of practical works	14	2	7	14
2.	Execution and test of laboratory works	36	4	9	36
3.	Express control works / test tasks	12	3	4	12
4.	Modular control work (MCW)	18	18	1	18
5.	Abstract	20	20	1	20
6.	Test work[1]	80	80	1	80
	Total				100

[1]*Accounted for in the amount of the rating together with the grade for CGW if the student has not scored 60 points per semester or he wants to improve his grade.*

The applicant receives a positive credit score for the results of the semester, if he has a final rating for the semester of at least 60 points and has met the conditions of admission to the semester control, which are determined by the RSE (Rating System of Evaluation).

With applicants who have met all the conditions of admission to the test and have a rating of less than 60 points, as well as with those applicants who want to increase their rating, in the last scheduled lesson in the semester, the teacher conducts semester control in the form of test or interviews.

After performing the test, if the score for the test is higher than the rating, the applicant receives a score based on the results of the test.

If the grade for the test is lower than the rating, a "hard" RSE is used - the previous rating of the applicant (except for points for the semester individual task) is canceled and he receives a grade based on the results of the test. This option forms a responsible attitude of the applicant to the decision to perform the test, forces him to critically assess the level of his training and carefully prepare for the test.

***Calendar control** (CC) - is performed twice a semester as monitoring of the current state of compliance with syllabus requirements.*

The purpose of calendar control is to improve the quality of student learning and monitor the implementation of the schedule of the educational process by students.

Criterion			The first CC	The second CC
Deadline of calendar controls			8th week	14th week
Conditions for obtaining a positive result from the calendar control	Current rating		≥ 15 points	≥ 40 points
	Execution practical work	PW № 1- 4	+	+
		PW № 5-7	-	+
	Execution laboratory works	LW № 1- 4	+	+
		LW № 5- 9	-	+
	Express control works / test tasks	№ 1-2	+	+
		№ 3-4	-	+
	Modular control work	Estimated MCW	-	+
	Abstract	Estimated Abstract	-	-

In case of detection of academic poor quality during training - the control measure is not credited.

Semester certification of students

Mandatory condition for admission to the test		Criterion
1	Current rating	RD ≥ 42
2	Obtaining a positive assessment for the abstract	More than 11 points
3	All practical works are tested	More than 3 points
	All laboratory works are tested	More than 9 points
4	Express control works / test tasks	More than 4 points

The results are announced to each student separately in the presence or remotely (by e-mail). Also recorded in the system "Electronic Campus".

Optional conditions for admission to closure:

1. *Activity in practical classes.*
2. *Activity in laboratory classes.*
3. *Positive result of the first attestation and the second attestation.*
4. *Attending of lectures.*

Table of translation of rating points to grades on a university scale:

Number points	Assessment on the university scale
100-95	Perfectly / Відмінно
94-85	Very good / Дуже добре
84-75	Good / Добре

74-65	*Satisfactorily / Задовільно*
64-60	*Enough / Достатньо*
Less 60	*Unsatisfactorily / Незадовільно*
Admission conditions are not met	*Not allowed / Не допущено*

9. Additional information on the discipline (educational component)

The list of questions for preparation for modular control work, and also for preparation for credit is given in appendix 1.

Distance learning through additional online courses on certain topics 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 with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Work program of the discipline (syllabus):

Compiled by *Senior Lecture of BME Department Valentyna Danilova*

Approved by *the Department of Biomedical Engineering (protocol № ___ to _____)*

Approved by *the Methodical Commission of the Faculty of Biomedical Engineering (protocol № __ to _____)*

Appendix 1 to the syllabus of the discipline

"Telemedicine and Computer Networks"

The list of questions for preparation for modular control work,

And also for preparation for test

1. Explain the concept of computer network.
2. Explain the concept: subscriber, server, client.
3. Classification of the network by bandwidth, size.
4. Classification of the network by the ratio of nodes and access.
5. Classification of the network by channel band and by common OS.
6. Purpose of the network.
7. Computer network architecture
8. The concept of topology.
9. Networks with ring topology (description, advantages, disadvantages).
10. Star-shaped topology (description, advantages, disadvantages).
11. Tire topology (description, advantages, disadvantages).
12. The concept of protocols and interfaces.
13. Wire lines
14. Coaxial cable
15. Twisted steam
16. Fiber optic cable
17. Wireless communication channels
18. Repeaters
19. Concentrators
20. Bridges
21. Switch
22. Router
23. Explain the concept of protocol, interface, stack of communication protocols
24. OSI model levels: applied, representative, session.
25. Transport level of the OSI model
26. Network layer of the OSI model
27. Channel and physical levels of the OSI model
28. Protocols with connection establishment, protocols without preliminary connection establishment.
29. Network-dependent and network-independent levels
30. IEEE 802.X CATEGORY STANDARDS
31. MAC and LLC levels
32. Types of LLC-level procedures
33. OSI stack
34. TCP / IP stack
35. Stack IPX / SPX
36. NetBIOS / SMB stack
37. Applied TCP / IP stack level
38. The main (transport) level of the TCP / IP stack
39. The level of interconnection of the TCP / IP stack
40. The level of network interfaces of the TCP / IP stack
41. TCP / IP stack address types
42. IP address classes
43. Special IP addresses

44. The use of 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 do Gigabit Ethernet technology have in common compared to Ethernet and Fast Ethernet technologies?
50. How 100VG-AnyLAN differs 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. Give the advantages of static routing.
56. What are the disadvantages of static routing?
57. Specify the algorithm for setting up static routing in the 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 NAT modes exist?
63. List the commands that you want to use when setting up NAT in static mode.
64. Specify the commands to use when configuring NAT in overload mode.
65. List the advantages of NAT technology.
66. Name the features of the RIP protocol.
67. Name the disadvantages and advantages of RIP.
68. Name the commands used in setting up the RIP protocol.
69. Specify the features of the OSPF protocol.
70. Give the algorithm of the OSPF protocol.
71. Compare the RIP and OSPF protocols, what are the disadvantages and advantages of each of them?
72. Specify the commands that are used to configure the OSPF dynamic routing protocol.
73. How do channel state protocols differ from remote-vector protocols?
74. Specify the features of the EIGRP protocol.
75. How is the EIGRP route metric calculated?
76. Give the algorithm of the EIGRP protocol.
77. Compare the EIGRP and OSPF protocols, what are the disadvantages and advantages of each of them?
78. Specify the commands used to configure the EIGRP dynamic routing protocol.
79. What is a virtual computer network?
80. Indicate the benefits of using local virtual computer networks.
81. What type of devices perform most of the work when using VLAN technology?
82. Give the commands needed to create a virtual computer network.
83. Indicate 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?