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

Department of Biomedical Engineering

Term paper on the subject "Biomedical Information Display Systems"

Work program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	***Second (master's)***
Branch of knowledge	*16 Chemical and bioengineering*
Specialty	*163 Biomedical Engineering*
Educational program	*Medical Engineering*
Discipline status	*Mandatory discipline*
Form of study	*full-time / day / mixed / remote*
Year of preparation, semester	*1 course, autumn semester*
The scope of discipline	*1 ECTS (30 hours)*
Semester control / control measures	*defense of course work*
Lessons schedule	*30 hours - independent work*
Language of instruction	*English*
Information about the course leader / teachers	*PhD. physical and mathematical Sciences, Associate Professor, Andriy Vyacheslavovich Solomin, a.solomin@kpi.ua ; andr-sol@i.ua ; Phone 0509271063*
Teacher profile	*https://intellect.kpi.ua/profile/sav231* *http://bmi.fbmi.kpi.ua/department/staff-department/*
Course placement	*Sikorsky (Moodle) https://do.ipo.kpi.ua/course/view.php?id=2283* *Individual video conference room Zoom 650 976 8233*

Curriculum of the discipline

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

The term paper is an integral part of the discipline "Biomedical Information Display Systems", which belongs to the mandatory disciplines of the cycle of general training of masters.
Term paper is one of the types of independent work of the student, which is aimed at mastering the skills of scientific and practical activities, it is a type of qualifying work designed to develop knowledge, skills and abilities to independently solve scientific and practical problems.

The purpose of the credit module
The purpose of writing a term paper - to summarize and systematize the knowledge and practical skills of students to perform research, justify its relevance, choose a approach to solving the problem, perform research and design results based on knowledge and skills acquired in mathematics and science. scientific training , professional and practical training.
In the process of working on the term paper students consolidate skills and abilities to work with scientific, normative and reference literature, learn to analyze existing approaches, methods of solving basic problems in the selected scientific problem, design the results in the form of completed work on a given structure and content. which meet the requirements for writing a term paper.

The subject of the credit module

The theme of the term paper corresponds to the objectives of the discipline "Biomedical Information Display Systems", is closely related to the practical needs of biomedical engineering and covers the sections "Digital signal and image processing", "Statistical methods of information processing", "Physical principles and means of obtaining biomedical information", "Modern systems for displaying biomedical information".

During training and for interaction with students modern information communication and network technologies are used, the corresponding online course in the Sikorsky (Moodle) system is developed and constantly improved .

Execution of the term paper consolidates and improves the possession of knowledge, skills and abilities in parallel with the assimilation of the material of the discipline in other forms (lectures, practical classes), which leads to the following program results.

Program competencies

General competencies

GC 1	*Ability to abstract thinking, analysis and synthesis.*
GC 2	*Ability to search, process and analyze information from various sources.*
GC 3	*Ability to identify, formulate and solve problems.*
GC 4	*Ability to work in a team.*
GC 5	*Ability to work in an international context.*

Special (professional) competencies:

PC 1	*Ability to solve complex problems of biomedical engineering using the methods of mathematics, natural and engineering sciences.*
PC 2	*Ability to develop a working hypothesis, plan and set experiments to test the hypothesis and achieve the engineering goal using appropriate technologies, technical means and tools.*
PC 3	*Ability to analyze complex medical engineering and bioengineering problems and formalize them to find quantitative solutions using modern mathematical methods and information technology.*
PC 5	*Ability to develop terms of reference for creation, as well as to model, evaluate, design and construct complex bioengineering and medical engineering systems and technologies.*
PC 6	*Ability to study biological and technical aspects of functioning and interaction of artificial biological and biotechnical systems.*
PC 7	*Ability to work in a multidisciplinary team.*
PC 11	*Ability to develop, plan and apply mathematical methods in the analysis, modeling of the functioning of living organisms, systems and processes in biology and medicine.*
FC 12	*Ability to perform research and observations on the interaction of biological, natural and artificial systems (prostheses, artificial organs, etc.), to plan biotechnical tests of artificial prostheses and systems.*

Program learning outcomes:

PLO 1	*Understanding of fundamental-applied, medical-physical and bioengineering bases of technologies and equipment for research of physiological and pathological processes of the person .*
PLO 2	*Understanding the principles of action of modern diagnostic equipment and display systems of biomedical information, the basis of appropriate software .*
PLO 3	*Possession of modern methods of scientific research software, construction of adequate theoretical models and methods of their substantiation..*

PLO 4	*Application of calculation methods and selection of classical and new designs of biomaterials, elements of devices and systems of medical appointment .*
PLO 5	*Application of methods and tools for designing computer networks .*
PLO 6	*Possession of methods of designing digital microprocessor and biotechnical systems for medical purposes*
PLO 7	*Possession methods research, design and construction of objects of biomedical engineering, analysis and processing of experimental data .*
PLO 8	*Knowledge of general requirements for the conditions of engineering, technological and scientific projects .*
PLO 9	*Knowledge of the principles of development and modern problems of creating biocompatible materials in medical practice.*
PLO 13	*Knowledge of a foreign language to an extent sufficient for general and professional communication*
PLO 15	*Understanding of specialized conceptual principles acquired in the process of learning and/or professional activity at the level of the latest achievements, which are the basis for original thinking and innovation, in particular in the context of research work.*
PLO 22	*Presentation of research and development results in the state and foreign languages in the form of applications for inventions, scientific publications, reports at scientific and technical events.*
PLO 24	*Mastery of adaptation skills and action in situations related to work in the specialty, the ability to generate new ideas in the field of biomedical engineering.*
PLO 25	*Implementation of achievements of domestic and foreign science and technology, use of creative initiative, rationalization, invention and best practices that ensure the effective operation of the medical enterprise.*

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

The discipline "Biomedical Information Display Systems" is interdisciplinary. It integrates according to its subject knowledge from other disciplines (bachelor's degree programs): "Physics", "Fundamentals of of computer science", "Engineering and computer graphics", "Biophysics", "Radiation safety and dosimetry", "Biomedical Devices, apparatus and complexes","Examination and engineering support of medical equipment","Devices for control of person's physiological parameters", etc. According to the structural and logical scheme of the master's program, the discipline is closely related to other disciplines of general and professional training: "Medical Physics", "Diagnostic and therapeutic methods in arrhythmology and electrophysiology".

The acquired practical skills and acquired theoretical knowledge during the study of the discipline "Biomedical Information Display Systems" can be used in the future during the acquisition of disciplines:

- from selective disciplines (educational-professional program "Medical Engineering"): "Physiotherapeutic medical devices", "Electronic sensors and biochips", " Biophotonics and nanoelectronics", "Medical devices and technologies".

The acquired practical skills and acquired theoretical knowledge during the study of the discipline "Biomedical Information Display Systems" can be used later in undergraduate practice, for the preparation of a master's thesis and in further practical work in the specialty.

Necessary skills

1. Knowledge and practical skills in solving problems in physics.

2. Possession of knowledge and methodology in biophysics

3. Knowledge of the basics of clinical engineering and radiology.

4. Possession of the methodology of registration and processing of biosignals and medical images.

3. The content of the credit module

The content of the term paper covers the following topics of the discipline "Biomedical Information Display Systems":

- *Discrete and continuous signals and images*
- *Digital signal and image processing*
- *Data analysis tools in biomedicine.*
- *Image formation and analysis in biomedicine. Physical principles and means of image formation*
- *Physical principles and means of image formation in the infrared range*
- *Acoustic and ultrasound research in biomedical engineering*
- *Physical principles and means of electromagnetic research*
- *Features and basic principles of obtaining biomedical information through the use of X-ray, gamma and nuclear radiation*
- *Computed tomography*
- *Magnetic resonance imaging*
- *Positron emission tomography*

Topics of term paper and initial data to them are chosen by students in coordination with the teacher.

The term paper is the final control measure, which covers all program learning outcomes. Deadline: definition of the topic - up to the 3rd week, public defense - the 17th- 18th week.

4. Training materials and resources

Basic literature

1. Eric J.Hall, Amato J.Giaccia. Radiobiology for the Radiologist. – Philadelphia: Wolters Kluwer, 2019. – 1161p.

https://filesdo.com/b2f4187148758478

2. N.Smith, A.Webb. Introduction to Medical Imaging. – New York: Cambridge University Press, 2011. – 300p.:

https://filesdo.com/0f91bc937cbbbeef?pt=wgXSuKpo9gyTI8wGqONIWW9rjay%2B3KE5yXw73nsJXew%3D

3. J.D.Bronzino. The Biomedical Engineering Handbook. – USA: Taylor & Francis Group, 2006. – 1404p.

https://www.academia.edu/42026274/The_Biomedical_Engineering_Handbook_Third_Edition_Biomedical_Engineering_Fundamentals

Additional literature:

4. Основи реєстрації та аналізу біосигналів. Навчальний посібник / О.Г. Аврунін, В.В. Семенець, В.Г. Абакумов, З.Ю. Готра, С.М. Злепко, А.В. Кіпенський, С.В. Павлов. – Харків: ХНУРЕ, 2019. – 400 с. – Режим доступу:

https://openarchive.nure.ua/bitstream/document/8514/3/Avruninbiosignal2019.pdf

5. Інтелектуальні технології в медичній діагностиці, лікуванні та реабілітації: монографія / [С. В Павлова, О.Г. Аврунінa, С.М.Злепка, Є.В.Бодянського та ін.]; за редакцією С.Павлова, О.Аврунінa. – Вінниця: ПП «ТД «Едельвейс і К», 2019. –260 с. – Режим доступу: https://openarchive.nure.ua/bitstream/document/8838/3/1Intel_Tech_Avrunin_2019.pdf

6. Біофізичні та математичні основи інструментальних методів медичної діагностики: Навч. Посібник / Є.В. Сторчун, Я.М. Матвійчук. – Львів: Вид. «Растр-7», 2009. – 216 с. – Режим доступу:

http://ena.lp.edu.ua/bitstream/ntb/22788/3/InstrMetMedDiagn.pdf

7. Лукин А. Введение в цифровую обработку сигналов (математические основы). – М: МГУ, 2007. – 54 с. – Режим доступу: http://audio.rightmark.org/lukin/dspcourse/dspcourse.pdf

8. Лапач С.Н., Чубенко А.В., Бабич П.Н. Статистические методы в медико-биологических исследованиях с использованием Excel. – 2-е изд., перераб. и доп. – К.: МОРИОН, 2001. – 408 с. – Режим доступу: http://knigi.tor2.org/?b=1186162

9. Илясов Л.В. Биомедицинская измерительная техника: Учебное пособие для вузов. – М.: Высш. шк., 2007. – 342 с. – Режим доступу: http://www.booksmed.com/luchevaya-diagnostika/1278-biomedicinskaya-izmeritelnaya-texnika-ilyasov.html

10. Марусина М.Я., Казначеева А.О. Современные виды томографии. Учебное пособие. – СПб: СПбГУ ИТМО, 2006. – 132 с. – Режим доступу: http://books.ifmo.ru/file/pdf/118.pdf

11. Визильтер Ю.В., Желтов С.Ю., Князь В.А., Ходарев А.Н., Моржин А.В. Обработка и анализ цифровых изображений с примерами на LabVIEW IMAQ Vision. – М.: ДМК Пресс, 2007. – 464 с. – Режим доступу: http://www.torrentino.me/torrent/199549

12. Матвійчук А.О., Чеховой М.В., Кисельова О.Г., Шликов В.В., Яценко В.П. Методи клінічної діагностики та терапії. Методичні вказівки до виконання лабораторних робіт – К.: НТУУ „КПІ”, 2014. – 76 с. – Режим доступу: https://do.ipo.kpi.ua/pluginfile.php/286938/mod_resource/content/1/%21%21_Matvijchuk_KPI_Metody%20clinichnoyi%20diagnostyky.pdf

13. Physics of image visualization in medicine: in 2 volumes. Vol.1: Per. with English / ed. S. Webb. - M.: Mir, 1991. - 408 s.

41. Physics of image visualization in medicine: in 2 volumes. Vol.2: Per. with English / ed. S. Webb. - M.: Mir, 1991. - 408 s. - Access mode: http://www.booksmed.com/luchevaya-diagnostika/1551-fizika-vizualizacii-izobrazhenij-v-medicine-uyebb-stiv-monografiya.html

Information resources

1. Sikorsky distance learning platform. - Access mode: https://do.ipo.kpi.ua/course/view.php?id=2283
2. Forum on computer image processing. - Access mode: https://forums.ni.com/t5/Machine-Vision/bd-p/200.
3. LabVIEW User Club. - Access mode: http://www.labviewportal.org .

The list of information resources includes the sources of their receipt, and then - the methods of mastering the educational component.

Educational content

5. Methods of mastering the educational component

The schedule of term paper with an approximate distribution of hours allocated for independent work of students is given in table 1.

Table 1

№ s / n	The name of the stage of the calendar plan	IVS, number of hours	Deadline, Week of the semester
1.	Clarify the topic and get the task. Acquaintance with requirements and terms of performance of course work	1	3
2.	Drawing up a plan for *term paper*	1	3
3.	Analytical review of literature sources on the topic of work, elaboration of theoretical material, selection of methods for solving problems	5	4 - 7
4.	Registration of section 1 according to requirements.	4	8
5.	Product design (software) according to the topic of the task	5	8-10
6.	Design (implementation) of the product (software) according to the topic of the task	5	11-14
7.	Product testing (software) according to the topic of the task . Registration of section 2 according to requirements.	4	14

8.	Formulation of conclusions. Registration of course work and annotations to it. Submission of work for verification	4	15 - 16
9.	Preparing a presentation. Defense of course work	1	17-18
	Hours in general	**30**	

Distance learning platform:

For more effective communication in order to understand the structure of the discipline "Biomedical Information Display Systems" and master the material used e-mail, telegram channel, distance learning platform "Sikorsky" based on the Moodle KPI-Telecom system and online meeting service Zoom , whereby:

- increases the efficiency of communication with students, provides convenient feedback;

- simplifies the placement, access and exchange of educational material;

- students' learning tasks are evaluated ;

- student activity is analyzed.

6. Independent student work

The term paper is a type of independent work of the student, which is performed under the guidance of the teacher and according to the topic agreed with him. Methodical recommendations for implementation and approximate topics of course work are given in Appendix 1..

Policy and control

7. Policy of educational component

Attending classes

Execution of term paper is carried out within the framework of independent work of students, for which 30 hours are planned.

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 "Biomedical Information Display Systems" 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.

Performing of term paper done during independent work of students and can be remotely (with the possibility of consulting with the teacher via email, social networks, Zoom-conference).

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 assignments, including the implementation of term paper.

Control measures missed

Term paper, submitted for inspection in violation of the deadline, but before the deadline for the current certification (or exam), is evaluated with penalty points.

Term paper, submitted for inspection in violation of the deadline and after the deadline for the current certification (or exam) is not evaluated.

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

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

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

Calendar control is performed at 8 and 14 weeks of the semester. The condition for obtaining a positive assessment of the calendar control over the educational component of "temp paper" is the student's compliance with the schedule of course work (see table 1, paragraphs 4, 7)

In case of academic dishonesty during training - the control measure is not credited.

Semester control

The defense of the temp paper is carried out during the last two weeks of study in the semester, before the examination session.

Condition of admission to the defense of the temp paper - the current rating ≥ 36 points.

To assess the results of the temp paper, the department creates a commission.

The credit grade for the temp paper is set based on the results of the defense of the work before the commission for the semester control.

The examiner and members of the commission, exercising semester control, have the right to ask additional questions for a more objective assessment of the course work.

Rating system for assessing learning outcomes

The rating assessment of the temp paper has two components:

1. The first (starting) characterizes the student's work to perform the tasks provided by the temp paper and its result - the quality of the explanatory note and graphic material.
2. The second component characterizes the quality of defense of the student's term paper.

The size of the scale of the starting component is 60 points (table 2), and the defense component - 40 points (Table 3).

Table 2

№ s / n	The first (starting) component of the temp paper	%	weight score	Number	Total
1.	Timeliness of stages of temp paper	10	5	2	10
2.	Availability and sufficient quality of all stages of design and construction of the product (software) according to the theme of the temp paper.	20	2 0	1	20

3.	Content and completeness of the topic	10	10	1	10
4.	Quality of graphic material (calculation schemes, tables, figures)	10	10	1	10
5.	Compliance of the temp paper with the requirements of design and regulations.	10	10	1	10
	Total				**60**

Table 3

№ s / n	The second component of the temp paper	%	weight score	Number	Total
1.	Degree of mastery of theoretical material and methods of solving the problem	20	20	1	20
2.	Substantiation of own opinion, logic and objectivity of conclusions	10	10	1	10
3.	Quality of report and presentation	10	10	1	10
	Total				**40**

Criteria for evaluating the two components of the temp paper are given in table 4.

Table 4

№ s / n	Components of the course work	Weight score	Evaluation criterion, percentage (%) of required information			
			not less than 90%	not less than 75%	not less than 60%	less than 50%
1.	Timeliness of stages of course work	10	10-9	8-7,5	7-6	5-0
2.	Availability and sufficient quality of all stages of design and construction of the product (software) according to the theme of the course work .	20	20-18	17-15	14-12	11-0
3.	Content and completeness of the topic	10	10-9	8-7,5	7-6	5-0
4.	Quality of graphic material (calculation schemes, tables, figures)	10	10-9	8-7,5	7-6	5-0
5.	Compliance of the temp paper with the requirements of design and regulations.	10	10-9	8-7.5	7-6	5-0
6.	Degree of mastery of theoretical material and methods of solving the problem	20	20-18	17-15	14-12	11-0
7.	Substantiation of own opinion, logic and objectivity of conclusions	10	10-9	8-7.5	7-6	5-0
8.	Quality of report and presentation	10	10-9	8-7.5	7-6	5-0

The sum of the scores of the two components is transferred to the credit score in accordance with table 5.

Table 5

№ s / n	**Scores**	**Rating**
1.	100… 95	Perfectly
2.	94… 85	Very good
3.	84… 75	Good
4.	74… 65	Satisfactorily
5.	64… 60	Enough
6.	Less than 60	Unsatisfactorily
7.	Failure to comply with the conditions of admission to the semester control	Not allowed
8.	Violation of the principles of academic integrity or moral and ethical norms of behavior	Removed

9. Additional information on the discipline (educational component)

The results are announced to each student separately in the presence or remotely (on the Sikorsky platform or by e-mail).

In case of academic dishonesty during distance learning - the control measure is not taken into account, the student is not allowed to defend.

Methodical instructions for the term paper are set out on the Sikorsky platform: https://do.ipo.kpi.ua/course/view.php?id=2283

Annex 1 . Methodical recommendations for the implementation and design of term paper

Term paper (TP) is performed in accordance with the requirements within a specified period.
It aims to master the ability to identify current issues; additional, in-depth study and practical awareness of certain sections of the curriculum; development of skills of independent work with scientific literature.
The student can perform TP only on the subject agreed with the teacher.
The TP may disclose, for example, the following topics:
1. Development of a system for measuring and analyzing blood pressure.
2. Development of a system for measuring and analyzing pulmonary pressure.
3. Development of a model of software and hardware for heart rate monitoring.
4. Development of a virtual electrocardiograph.
5. Development of iridodiagnostics system.
6. Development of a time series recognition system.
7. Development of rapid diagnostic tools in the LabVIEW environment.
8. Development of a virtual device for measuring the speed of pulse wave propagation.
9. Development of a system for monitoring the temperature of internal organs.
10. Development of a virtual tool for generating test audio signals for diagnosing human hearing.
11. Development of a system of wavelet analysis of heart signals.
12. Development of a virtual device for measuring heart murmurs.
13. Development of virtual equipment for assessing the state of the human cardiovascular system.
14. Development of a system for the study of human cardiointervalogram.
15. Development of a virtual device for diagnosing human color blindness.
16. Development of a virtual device for determining the speed of human response.
17. Development of a virtual device to test the statistical probability of the existence of the influence of biorhythms (phases of the moon) on the human condition (eg, reaction rate or heart rate).

18. Development of a virtual device for diagnosing a person's mental state (for example, by associations that arise when considering drawings).
19. Virtual device for analysis of electrocardiograms.
20. Virtual device to improve the quality of electrocardiograms.
21. Virtual device for semi-automated processing of echocardiograms.
22. Virtual device for processing and improving the quality of X-ray images.
23. Virtual device for semi-automated processing and analysis of electroencephalograms.
24. 3D-reconstruction of biomedical objects according to computed tomography.
25. Virtual device for measuring and monitoring noise in the room.
26. Virtual device for pre-processing of microscopic images in biomedicine.
27. Virtual devices for statistical information processing in biomedicine.

Students can also suggest and agree with the teacher their topic

Execution of the course work consists of two stages: development of product creation (software product (SP)) and writing of the corresponding explanatory note to this product (SP).
SP is demonstrated in action on a computer, defended and evaluated by the teacher in one of the practical classes, and an explanatory note in hard copy is provided to the teacher no later than 2 weeks before the last day of classes in the semester.
The title page of the course work 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, registration number, name of academic discipline; theme of the temp paper; surname and name of the student, course, number of the academic group, year.
The title page is followed by a detailed plan (content) of temp paper, which should highlight the entry, 2-3 main sections of content, conclusion, the list of sources. 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 course work, depending on the chosen topic can vary from 20 to 30 pages of the main text. The scope of the temp paper is determined by the student's ability to briefly and comprehensively reveal the topic: relevance of the topic, current trends and problems, analyze the best foreign and Ukrainian technologies, draw conclusions and justify their own suggestions and recommendations.
An annotation is provided for the course work in two languages - Ukrainian and English, with the indication of key words.
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 source number in the list of references at the end of the work, and the second digit - the page number in this source). Be sure to use tables, charts, 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.
Term paper is evaluated by the following criteria: logic of the plan; completeness and depth of disclosure of the topic; availability of illustrations (tables, figures, diagrams, screenshots of web pages, etc.); the number of sources used and the clarity of references to them; design; substantiation of the student's own opinion on this issue in the form of a conclusion.
Evaluation system : a) the program itself (SP) and explanatory note, b) protection.
Sequence of delivery of stages:

- *Demonstration of a working program;*
- *Submission of a fully explanatory note.*
- *Placement of annotations of the TP on the website of the department.*
- *Defense of the TP.*

Deadline for submission of term paper for review: 2 weeks before the end of classes.
The term paper is checked for plagiarism, and before the defense the abstract is posted on the website of the department.

Credit module work program (syllabus) :

Developed: Associate Professor, PhD, Solomin Andriy Vyacheslavovich

Approved by the Department of Biomedical Engineering (protocol № 13 of 25.06.2021);

Approved by the Methodical Commission of the Faculty of Biomedical Engineering (protocol № 11 of 25.06.2021)