NATIONAL TECHNICAL UNIVERSITY OF UKRAINE

“IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE”

FACULTY OF BIOMEDICAL ENGINEERING

APPROVED

Department of educational process organization
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«___»_____ 2021

F-CATALOG

ELECTIVE ACADEMIC DISCIPLINES OF

THE CYCLE OF PROFESSIONAL TRAINING

for Bachelor's degree students

educational program “Medical engineering”

specialty 163 Biomedical engineering

APPROVED:

Methodological council
Igor Sikorsky KPI
(protocol №_6_ as of «_25_»__02__2021)

Academic council of
the faculty of biomedical engineering
Igor Sikorsky KPI
(protocol №_11_ as of «_22_»__02__2021)

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Regulations on the students` right to select academic disciplines

According to the Section X of Article 62 of the Law of Ukraine "On Higher Education" (№ 1556-VII of 01.07.2014), Elective disciplines are the disciplines of the student`s free choice for a certain level of higher education. They are aimed to provide general and special (professional) competencies within the specialty. Elective courses should comprise no less than 25% of the total number of ECTS credits for the level of education.

The catalog contains an annotated list of disciplines offered for selection by graduate students of the first educational and research level of higher education under the curriculum.

The procedure by which the students are able to choose academic disciplines includes the following stages:

- provide the students access to the list of elective disciplines corresponding to the educational components for a particular academic year;
- departments of the faculty provide students with an ability to indicate their choice of appropriate educational components through questionnaires, test forms, etc.
- students are required to choose elective disciplines from the general university catalog via the “Electronic campus” system following the procedure approved by the University (“Regulations on the Individual curriculum of a student of Igor Sikorsky KPI”);
- students are required to choose elective courses from the F-Catalogs of the interdepartmental/departmental catalogs following the procedure approved by the Faculty of Biomedical Engineering by choice means indicated by each department of the faculty;
- student choice of educational components is counted at the departments along with the dean's office to form study groups of chosen disciplines with regards to the normative and/or the minimum number of students in the group. The normative number of students in groups to study the discipline of the cycle of professional training for master students is 5-25 (minimum of 5 students);
- provided that it is impossible to form study groups with the normative or minimum number for studying a certain discipline, students are usually given another round of choice indication within previously formed groups. In some cases, upon a substantiated application and decision of the providing department, it is possible to study the chosen discipline with the help of other forms of education (individual consultations, mixed form of education, etc.). In case the number of students within a group does not meet the minimum, preference is given to a mixed form of education;
- the final decision made by students on the choice of educational components for the next academic year is documented with a written application. The results of the student's

choice of academic disciplines are noted in the individual curriculum for the next academic year in the section “Elective disciplines”.

Generalized information on the disciplines chosen by students and the formation of groups for their study is the basis to include the aforementioned disciplines in the calculation of the workload in relevant departments for the next academic year.

In case a student could not choose the discipline in time due to a serious circumstance or found a mistake in his indication of choice, it is advised to submit the application for enrollment in the study of the chosen discipline to the dean's office, providing relevant documents. A student who has neglected the right to indicate the choice will be included in the study of disciplines considered by the head of the graduating department in order to optimize study groups.

The catalog of elective disciplines of the Department of Biomedical Engineering comprises an annotated list of disciplines offered for selection by students of the first (Bachelor`s) level of HE in accordance with the curriculum for the next academic year:

– first-year students indicate the choice of disciplines for the second course of training;
– second-year students indicate the choice of disciplines for the third course of training;
– third-year students indicate the choice of disciplines for the fourth course of training;
– first and second-year students enrolled in the accelerated Bachelor's program indicate the choice of the discipline according to their curriculum.

F-Catalog 2021
Disciplines for acquiring professional competencies
(during the 3rd course 43 ECTS credits are chosen)

№	Educational component	Name of academic discipline	Semester	Number of ECTS credits	Semester control
1	EC-1	Biomedical mechanics	5	4	test
2	EC-1	Applied mechanics	5	4	test
3	EC-1	Engineering mechanics	5	4	test
4	EC-2	Theory of biomedical signals	5	4	test
5	EC-2	Registration and processing of biosignals and medical images	5	4	test
6	EC-2	Industrial pharmacy	5	4	test
7	EC-3	Telemedicine and computer networks	5	4	test
8	EC-3	Computer network design	5	4	test
9	EC-3	Automated design systems	5	4	test
10	EC-4	Theory of automatic control	5	4	test
11	EC-4	Design of automatic control and management systems	5	4	test
12	EC-4	Biomedical products technologies	5	4	test
13	EC-5	Biophysical converters	6	4	test
14	EC-5	Measuring converters and sensors	6	4	test
15	EC-5	Biomedical sensor systems	6	4	test
16	EC-6	Medical statistics	6	4	test
17	EC-6	Medical information systems	6	4	test
18	EC-6	Statistical methods in	6	4	test

		biomedical research			
19	EC-7	Biothermodynamics and mass-transferring	6	4	test
20	EC-7	Thermodynamics of biological processes and systems	6	4	test
21	EC-7	Thermobionics	6	4	test
22	EC-8	Fundamentals of design and engineering of medical equipment in SolidWorks	6	4	test
23	EC-8	Fundamentals of design and engineering of medical equipment in ANSYS	6	4	test
24	EC-8	Fundamentals of design and engineering of medical equipment in COMSOL	6	4	test

Disciplines for acquiring professional competencies
(during the 4th course 24 ECTS credits are chosen)

№	Educational component	Name of academic discipline	Semester	Number of ECTS credits	Semester control
25	EC-9	Mathematical modeling of biomedical systems	7	4	test
26	EC-9	Design of medical information systems	7	4	test
27	EC-9	Multidimensional statistical analysis	7	4	test
28	EC-10	Laboratory analytical equipment	7	4	test

29	EC-10	Modern optoelectronic diagnostic devices	7	4	test
30	EC-10	Fundamentals of laser laboratory methods of biomedical research	7	4	test
31	EC-11	Theory of inventive problem solving	7	4	test
32	EC-11	Algorithms for solving practical problems of science and technology	7	4	test
33	EC-11	Biopharmaceutical engineering	7	4	test
34	EC-12	Therapeutic medical equipment	8	4	test
35	EC-12	Development and operation of physiotherapeutic medical devices	8	4	test
36	EC-12	Therapeutic and diagnostic complexes based on biophotonic converters	8	4	test
37	EC-13	Methods and means of diagnosing human pathology	8	4	test
38	EC-13	Quality management system in medicine	8	4	test
39	EC-13	Functional diagnostics	8	4	test
40	EC-14	Technology for building software	8	4	test

		products			
41	EC-14	Web-based software development	8	4	test
42	EC-14	Web-technology and web-design	8	4	test

Disciplines chosen by students of the 3rd year of training

Discipline 4 F-Catalog

Discipline	**Theory of biomedical signals**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Electronic engineering department FEL
Entry requirements	Knowledge of physics and higher mathematics, methods of object-oriented programming, basics of analog and digital circuitry.
What will be studied	- methods of registration, reading and visualization of biomedical signals with the help of computer equipment; - methods of processing one- and two-dimensional signals in biomedical computer systems; - methods for calculating the parameters of one- and two-dimensional biomedical signals useful for diagnostic automation.
Why is it relevant and important	The development of modern biomedical systems involves the need to reasonably select, use and improve existing methods of signal processing and analysis, the ability to use the latest computer systems to calculate the parameters of one- and two-dimensional biomedical signals useful for diagnostic automation.
What is taught (learning outcomes)	**knowledge:** - methods of designing biotechnical and medical devices and systems; - use of methods of analysis and signal processing in medical devices and systems; - generalization and implementation in practice of advanced scientific and technical experience; - methods and research methods used in the design of medical equipment. **skills:** - to design biotechnical and medical devices and systems; - apply methods and tools of computer modeling, design and construction of medical devices and medical devices; - plan experiments and perform analysis and calculations based on the obtained experimental data; - solve professional scientific and engineering problems.

How to apply acquired knowledge and skills (competencies)	- apply signals and methods of their research in related biomedical systems, in accordance with the specialization of the faculty, - using methods of digital signal processing in the preparation of diploma projects and works, as well as in course design
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 5 F-Catalog

Discipline	**Registration and processing of biosignals and medical images**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Electronic engineering department FEL
Entry requirements	Knowledge of the basics of physics and higher mathematics, computer science and object-oriented programming, electrical engineering and electronics.
What will be studied	Basics of receiving and processing of continuous and discrete signals. Digital signal and image processing. Data analysis tools in biomedicine. Physical principles and means of obtaining biomedical information (sensors). Physical principles and means of forming images 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.
Why is it relevant and important	The most important areas of this discipline are computed tomography, MRI, positron emission tomography, which are now developing extremely rapidly and require an increasing number and quality of specialists. In addition, the display system is one of the main subsystems of any diagnostic equipment.
What is taught (learning outcomes)	**knowledge:** - basic principles of organization and structure of information and measuring systems, - basics of the theory of pattern recognition, artificial intelligence and expert systems, monitoring and forecasting systems, intellectual information technology, - modern engineering and information tools for creating, designing and testing systems for diagnosis and therapy, visualization of biomedical information, the possibility of using professional software to solve problems of biomedical engineering. **skills:** -- develop, calculate and analyze schemes of intelligent medical information

	measuring instruments, monitoring and forecasting systems, systems diagnostics, - solve problems of information and measuring equipment with the help of image recognition systems, artificial intelligence and expert systems, .- use the capabilities of hardware and software of artificial intelligence and expert systems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used in the development, operation, maintenance and improvement of existing biomedical systems, as the information display subsystem is always an interface that allows the diagnostician to interact with the appropriate equipment.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 6 F-Catalog

Discipline	**Industrial pharmacy**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Department of translational medical bioengineering
Entry requirements	Knowledge of the basics of anatomy, physiology, human biochemistry, mathematics, mechanics, biophysics
What will be studied	During the study of the discipline will be considered the basic classifications of finished dosage forms, the basic rules and requirements for the technology of manufacture and quality control of finished dosage forms. Requirements for excipients used in the manufacture of finished dosage forms. The main technological processes used in the production of finished dosage forms. Modern regulatory requirements for technological processes of manufacturing finished dosage forms. Requirements for storage of finished dosage forms.
Why is it relevant and important	The discipline is interesting to study, because the understanding of different technological processes, quality control methods in the production process and finished dosage forms and requirements for finished forms is a necessary basis for creating new and improving existing technologies of finished dosage forms.
What is taught (learning outcomes)	**knowledge:** - modern requirements of regulatory documentation governing the technology and quality control of pharmaceuticals in Ukraine and abroad; - rules of rational technology of various drugs and the necessary equipment; - the influence of physical and chemical properties of drugs on the technology of manufacturing finished dosage forms; - the procedure for maintaining production documentation of the technological process; - **skills:** - use normative, reference and scientific literature to solve professional problems; - search for professional tasks; - be able to work with regulatory and technical documentation governing the production process, quality of medicines and requirements for them; - be able to develop technological schemes for the

	production of various dosage forms and perform basic technological calculations; - to select rational methods of quality control of medicines.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to develop the technology of obtaining the finished drug, the choice of excipients for its manufacture and type of packaging. To select the methods of control of the technological process and the finished drug.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 7 F-Catalog

Discipline	**Telemedicine and computer networks**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of methods of volume-oriented programming, software
What will be studied	Construction of telemedicine networks at the local (individual settlements), regional (districts, regions) and national levels, taking into account the peculiarities of the region; classification model of telemedicine networks construction; method of choosing the optimal construction option telemedicine networks; application of three basic types of telemedicine services in different medical specialties / directions; development of standard design documentation for the construction of telemedicine networks, including recommendations for the choice of hardware and Software.
Why is it relevant and important	It is interesting to study the discipline, because telemedicine is a modern field that is evolving every year and which is relevant today.
What is taught (learning outcomes)	**knowledge:** - basic terms and their definitions; - modern technologies and structural organization of networks; - standardization of networks and protocols for information transmission; - network hardware; - topologies of local and global networks; - methods of access in local networks; - digital data networks; - Internet network technologies; **skills:** - develop telemedicine networks; - selection of topologies for computer network design; - selection of the necessary software, namely network equipment for computer network design; - development of standard design documentation for the construction of telemedicine networks, including recommendations for the choice of hardware and software.

How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to choose the best option for building telemedicine networks.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 8 F-Catalog

Discipline	**Computer network design**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of object-oriented programming methods, software
What will be studied	Basic concepts of computer networks; global and local computer networks, their topologies; logical organization of the network, client-server technology; network equipment, namely: routers, switches, modems, network, file servers; reference models of open systems interaction; methods of access in local networks; interaction of workstations in global networks; packet switching network protocols; data transmission systems of computer networks; data transmission channels, error protection; digital data transmission networks; LAN protocols; Internet network technologies.
Why is it relevant and important	It is interesting to study the discipline, because computer networks are a modern trend that is evolving every year and which is an integral part of medical information and measurement systems.
What is taught (learning outcomes)	**knowledge:** - basic terms and their definitions; - modern technologies and structural organization of networks; - standardization of networks and protocols for information transmission; - network hardware; - topologies of local and global networks; - reference model of open systems interaction; - methods of access in local networks; - digital data networks; - Internet network technologies; **skills:** - develop block diagrams of local area networks or upgrade them by choosing compatible network equipment, including the development of Internet communication schemes; - selection of topologies for computer network design; - selection of the necessary software, namely network equipment for computer network design;

	- calculate the cost of a local area network; organize and control the operation of hardware and software of computer networks.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to design and calculate the parameters of technical means of local networks in the design of biomedical equipment.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 9 F-Catalog

Discipline	**Automated design systems**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of bachelor's degrees: "Mathematics", "Physics", "Computer Science and Computer Engineering", "Descriptive Geometry, Engineering and Computer Graphics".
What will be studied	Issues related to the use of methods and techniques of automated design of devices and systems in medical instrumentation.
Why is it relevant and important	The use of computer-aided design systems in medical instrumentation involves the ability to transfer the technical task from the language of problem-based to the language of mathematical schemes and models and further into special software developed for medical devices and systems.
What is taught (learning outcomes)	**knowledge:** **-** biotechnical object, process, design system; - apparatus for processing and analysis of input and output information about the object, process, system and environment; - mathematical models, i.e. the art of problem statement and formalization, which consists in the ability to translate the technical problem from the language of problem-based to the language of mathematical schemes and models and further into special software; - methods of finding the optimal solution; - appropriate software for computer-aided design systems; **skills:** - develop, calculate and analyze schemes of intelligent medical information measuring instruments, monitoring and forecasting systems, systems diagnostics, - to solve problems of information and measuring equipment with the help of image recognition systems, artificial intelligence and expert systems; - use the capabilities of hardware and software of artificial intelligence and expert systems.

How to apply acquired knowledge and skills (competencies)	Knowledge and ability to transfer the technical task from the language of problem-based content to the language of mathematical schemes and models and further into special software, which is developed for medical devices and systems and diagnostic systems.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 10 F-Catalog

Discipline	**Theory of automatic control**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of such disciplines and sections of disciplines: higher mathematics, ordinary differential equations, linear algebra, Laplace and Fourier transforms, discrete mathematics, calculus of variations, spectral theory, probability theory, theoretical mechanics (dynamics), theoretical foundations of electrical engineering, analog circuitry,
What will be studied	The discipline consists of two sections: analysis of automatic control systems and synthesis of these systems. Analysis - the known characteristics of the constituent elements of biotechnical systems to calculate their quality. Synthesis - to design an automatic control system according to the set quality indicators, choosing the parameters of the elements, the parameters of which we can change. Special sections: Elements of the theory of optimal systems, Kalman filters, robotics. Study with the use of the most modern licensed system of electronic-technical modeling of bioengineered systems MicoCap-12.
Why is it relevant and important	All biological systems of man, animals, plants are subject to the basic laws of management theory. Almost all technical control systems use similar ideas. The acquired knowledge is necessary for a correct and deep understanding of the functioning of complex electronic medical devices.
What is taught (learning outcomes)	**knowledge:** - basic principles of organization and structure of information and measuring systems, - modern engineering and information tools for creating, designing and testing diagnostic and therapy systems; **skills:** - be well versed in the basic laws of operation of complex biological and bioengineering systems; - choose and justify the use of electronic components in the design of medical equipment; - to carry out mathematical modeling of biological systems and to create their mathematical models; - to ensure the effective use of means of design and

	manufacture of medical equipment and medical devices; - choose methods and tools tools for the implementation of technical projects, to apply modern methods and methods of modeling in the design of medical equipment and medical devices
How to apply acquired knowledge and skills (competencies)	- - carry out service, preventive, repair work and design of complex medical systems; - - conduct research, obtain and document results and draw scientifically sound conclusions based on their analysis; - - to ensure the effective use of means of design and manufacture of medical equipment and medical devices; - - choose methods and tools for the implementation of technical projects, apply modern methods and methods of modeling in the design of medical equipment and medical devices.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 11 F-Catalog

Discipline	**Design of automatic control and management systems**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of such disciplines and sections of disciplines: higher mathematics, ordinary differential equations, linear algebra, Laplace and Fourier transforms, discrete mathematics, calculus of variations, spectral theory, probability theory, theoretical mechanics (dynamics), theoretical foundations of electrical engineering, analog circuitry,
What will be studied	The discipline studies the synthesis of automatic control systems - according to the specified quality indicators of the design of automatic control systems, the choice of parameters of system elements that can be changed. Special sections: Elements of the theory of optimal systems, Kalman filters, robotics. Study with the use of the most modern licensed system of electronic-technical modeling of bioengineered systems MicoCap-12.
Why is it relevant and important	All biological systems of man, animals, plants are subject to the basic laws of management theory. Almost all technical control systems use similar ideas. The acquired knowledge is necessary for a correct and deep understanding of the functioning of complex electronic medical devices.
What is taught (learning outcomes)	**knowledge:** - basic principles of organization and structure of information and measuring systems; - modern engineering and information tools for creating, designing and testing diagnostic and therapy systems; **skills:** - be well versed in the basic laws of operation of complex biological and bioengineering systems; - choose and justify the use of electronic components in the design of medical equipment; - to carry out mathematical modeling of biological systems and to create their mathematical models; - to ensure the effective use of means of design and manufacture of medical equipment and medical devices; - choose methods and tools

	tools for the implementation of technical projects, to apply modern methods and methods of modeling in the design of medical equipment and medical devices
How to apply acquired knowledge and skills (competencies)	- carry out service, preventive, repair work and design of complex medical systems; - conduct research, obtain and document results and draw scientifically sound conclusions based on their analysis; - to ensure the effective use of means of design and manufacture of medical equipment and medical devices; - choose methods and tools for the implementation of technical projects, apply modern methods and methods of modeling in the design of medical equipment and medical devices.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 12 F-Catalog

Discipline	**Biomedical products technologies**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Department of translational medical bioengineering
Entry requirements	Knowledge of the basics of anatomy, physiology, human biochemistry, mathematics.
What will be studied	Theoretical bases concerning rules and requirements of creation, manufacturing, standardization, biopharmaceutical estimation, improvement of technologies of biomedical production. Classifications of biomedical products by functional and consumer characteristics. Theoretical bases of processes of production of biomedical products, pharmaceutical factors (form, physical and chemical condition of substance, technological process); basic requirements for storage of biomedical products; the choice of packaging and its impact on the stability of the finished product; general requirements for ready-made forms and methods of their provision.
Why is it relevant and important	It is interesting to study the discipline, because the understanding of different technological processes, standardization parameters and requirements for ready-made forms is a necessary basis for creating technology for various types of biomedical products.
What is taught (learning outcomes)	**knowledge:** - basic regulatory and technical documents governing the production of biomedical products; - classification of biomedical products; - methods of manufacturing biomedical products; - main and auxiliary stages of the technological process; - composition of finished forms of biomedical products; - range and characteristics of excipients used in the production of biomedical products; - determination of characteristics and requirements for biomedical products; - modern type of packaging, quality assessment and prospects for further improvement of manufacturing technology; - basic approaches to standardization of biomedical products;

	- theoretical aspects of studying the stability of biomedical products. **skills:** - use normative, reference and scientific literature to solve professional problems; - search for professional tasks; - work on equipment and apparatus for obtaining finished and intermediate products; - taking into account the properties of substances and auxiliary materials to find the best option in the methods of preparation of biomedical products; - perform technological calculations; - to conduct physico-chemical and technological studies of finished products; - evaluate the quality of the prepared product in accordance with the NTD; - ensuring the stability of products; - draw up specifications for finished biomedical products.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to determine the affiliation of biotechnological products to a particular class. When selecting the finished form of the product, excipients for its manufacture and type of packaging. To select the main and auxiliary stages of the technological process of obtaining and controlling a certain type of biomedical products.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 16 F-Catalog

Discipline	**Medical statistics**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of probability theory, methods of systematization of experimental information.
What will be studied	Methods of modeling and statistical research to solve problems related to the study of biological and medical systems, as well as public health and the activities of health care facilities.
Why is it relevant and important	To maintain and strengthen the health of the population requires quality information and timely modernization of the system of statistical monitoring of the state of health of the population and the development of health care. It is necessary to be able to properly organize and plan preclinical and clinical studies, as well as to process the results of medical and biological research.
What is taught (learning outcomes)	**knowledge:** - basic techniques, methods and techniques of collecting statistical information, the organization of statistical observation; - various methods of statistical aggregation, aggregation and grouping of data; - methods of object research, analysis and processing of experimental data; - methods of systematization and processing of experimental information; **skills:** - apply statistical methods of analysis of communication and dynamics of phenomena; - collect, process and analyze the initial data needed to calculate indicators that characterize the health of the population and the activities of health care facilities; - analyze and interpret statistics of medical and biological processes and phenomena, identify trends in indicators; - use databases, mathematical and software for data processing and computer modeling of biotechnical systems.

How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used in the field of methodology of medical research and application of methods of mathematical statistics in medical and biological research.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 17 F-Catalog

Discipline	**Medical information systems**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Fundamentals of system design and programming, basics of operating systems.
What will be studied	Features of processing and presentation of information in medical information systems, standards of transmission and storage of medical information, features of implementation of medical information systems for each level of medical care.
Why is it relevant and important	To analyze and process biomedical information, you need to know the principles of storage, retrieval, processing and analysis of biomedical information using computer technology.
What is taught (learning outcomes)	**knowledge:** - types, structures and characteristics of medical information systems; - the main directions of development of modern medical information systems; - principles of automation and management of health care facilities using modern computer technology; - types of unified forms of medical documentation used in medical organizations. **skills:** - determine the functionality of medical information systems; - use technical means used in the construction and operation of medical information systems; - application of expert systems for diagnostics, management and decision-making; - to accompany to improve the basic information processes in medical information systems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used in the informatization of management in the health care system and its employees, to automate medical processes.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua

Form of study	Lectures, practical classes
Semester control	test

Discipline 18 F-Catalog

Discipline	**Statistical methods in biomedical research**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of probability theory, methods of systematization of experimental information.
What will be studied	Theoretical and methodological bases of biomedical data formation, principles and methods of data collection, statistical processing and data analysis.
Why is it relevant and important	The current level of research in the field of preventive and clinical medicine requires the use of mathematical statistics to scientifically substantiate the reliability of results and conclusions.
What is taught (learning outcomes)	**knowledge:** - main types of data and types of measurement scales in which they are obtained; - basic descriptive statistics of quantitative and qualitative data; - methods of testing statistical hypotheses; - basic methods of multidimensional statistics; - application of application software for working with biomedical data. **skills:** - apply appropriate methods of data processing and analysis in practice; - use the acquired knowledge in solving relevant practical and research tasks; - choose a statistical criterion for testing hypotheses; - prepare data for statistical analysis and manage them using statistical software packages; - independently analyze biomedical data and draw appropriate conclusions.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used not only in conducting their own biomedical research, but also to understand the results of domestic and foreign research.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes

Semester control	test

Discipline 19 F-Catalog

Discipline	**Biothermodynamics and mass-transferring**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of higher mathematics, physics; biochemistry; mechanics, biophysics, quantitative human physiology;
What will be studied	Biological chemical systems and processes based on the general laws of heat conversion, different types of biosystems and energy
Why is it relevant and important	To determine the most energy-efficient ways of energy conversion in biosystems to determine the efficiency. performing useful work in a living organism. It is advisable to maximize the functional activity of cells and cell structures, the main thing - to support mass transfer.
What is taught (learning outcomes)	**knowledge:** - laws of thermodynamics and their application to describe thermodynamic systems; - quantitative patterns of energy conversion during various biochemical processes; - physical, biophysical and physicochemical patterns in experimental, theoretical and design activities; **skills:** - check experimentally the integrity and efficiency of biotechnical elements and determine their characteristics; - solve systems of heat and mass transfer equations to study the dependence of the process on a large group of heat transfer and mass transfer criteria.
How to apply acquired knowledge and skills (competencies)	Laws of thermodynamics and ways of their application for the decision of theoretical bases and methods of increase of efficiency of mass transfer processes in biosystems from the point of view of thermodynamics. To solve the regularity of heat transfer by thermal conductivity, radiation and convection, a description of heat transfer processes in the layer is given, the basics of the theory of heat exchangers and mass transfer processes in biological processes are stated.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical

	classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 20 F-Catalog

Discipline	**Thermodynamics of biological processes and systems**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of higher mathematics, physics; biochemistry; mechanics, biophysics, quantitative human physiology; biology.
What will be studied	Mechanisms of energy transformation in a living organism and determination of the most energy-efficient ways of energy conversion into useful work in a living organism. . Establishing a connection between the structure of matter and its reactivity
Why is it relevant and important	Thermodynamics of biological systems studies the transformation of energy and its transformation in a living organism. The very existence of a living organism and all the processes of life in it are closely related to the change of energy balance in the system "living organism - environment". The laws of thermodynamics are universal for inanimate and animate nature. The laws of thermodynamics are important unifying principles of the science of biology.
What is taught (learning outcomes)	**knowledge:** - laws of thermodynamics and their application to describe thermodynamic systems; - quantitative patterns of energy conversion during various biochemical processes; - physical, biophysical and physicochemical patterns in experimental, theoretical and design activities; **skills:** - check experimentally the integrity and efficiency of biotechnical elements and determine their characteristics; - predict the energy efficiency of various types of work in living organisms; - to choose methods of protection of biotechnical elements from action of external factors, and methods of increase of their functioning identify promising areas of research.
How to apply acquired knowledge and skills (competencies)	Apply thermodynamic laws to determine ways to regulate chemical processes (metabolism) in all biological organisms. And also, to determine the

	relationship between heat release in the process of metabolism and the performance of various works: chemical, mechanical, osmotic and electrical. Apply thermodynamic methods to establish the principles of the most efficient conversion of different types of energy and provides an answer to the primary question from a practical point of view on how to organize the work process. Thermodynamics makes it possible to predict and evaluate the effectiveness of various new ways of obtaining useful work, which is crucial for choosing the direction of development of biomedicine.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 21 F-Catalog

Discipline	**Thermobionics**
Level of higher education	First (Bachelor`s)
Course	3
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of higher mathematics, physics; biochemistry; mechanics, biophysics, quantitative human physiology; biology.
What will be studied	Structural and functional features of the body temperature maintenance system. Mechanisms of heat and mass transfer of biological systems. The main processes of thermoregulation of living organisms and maintenance of homeostasis of the organism as a mechanism for maintaining the stability of the living system.
Why is it relevant and important	The existence of a living organism and all the processes of life in it are closely related to the change of energy balance in the system "living organism - environment". Thermobionics studies the transformation of energy and its transformation in a living organism to determine the laws of heat and mass transfer in the biosystem. Allows to establish ways of the most effective transfer of thermal energy that gives the chance to predict and estimate efficiency of various ways of receiving useful work, and has crucial value for development of biomedical technologies.
What is taught (learning outcomes)	**knowledge:** - structural and functional features of the body temperature maintenance system; - mechanisms of heat and mass transfer of biological systems .; - mechanisms of heterogeneous mass transfer; - basic processes of thermoregulation of living organisms; - mechanisms of heat and mass transfer in the system "organism-environment"; - quantitative patterns of energy conversion during various biochemical processes; - quantitative patterns of heat and mass transfer in the functioning of body systems; **skills:** - predict the energy efficiency of various types of work in living organisms; - choose methods to improve the functioning of biosystems

	- to model the processes of heat and mass transfer by air and water currents and the oxidation processes of substances in living organisms. - to determine promising areas of scientific activity.
How to apply acquired knowledge and skills (competencies)	- apply the laws of heat and mass transfer to predict the work of complex biosystems based on knowledge about the thermal conductivity of body tissues. - apply thermodynamic laws to determine ways to regulate the biochemical processes of a living organism - modeling of the heat exchange mechanism in a living system - to determine the ways of optimal regulation of complex biosystems on the basis of knowledge about the thermal conductivity of body tissues. - apply theoretical knowledge to create -medical biotechnical systems - work with the bionic model of living things - predict the consequences of their professional activities
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Disciplines chosen by students of the 4th year of training

Discipline 25 F-Catalog

Discipline	**Mathematical modeling of biomedical systems**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of medical statistics, methods of grouping and analysis of the results
What will be studied	Application of methods of mathematical statistics in medical and biological research, models and methods of mathematical statistics for interpretation of the obtained results, statistical methods and criteria for solving problems of medical and biological research.
Why is it relevant and important	For the development of professional knowledge in the field of methods of organization and statistical analysis of the results of medical research in the experiment.
What is taught (learning outcomes)	**knowledge:** - algorithms for selecting the necessary method or criterion for solving a specific problem of biomedical research; - algorithms for performing the selected method of mathematical statistics and interpretation of the results; - methodical bases and criteria of a choice of the basic adequate methods of the analysis for check of statistical hypotheses; - theoretical and methodological bases of the analysis of statistical results, their estimation and the description for the purpose of formation of the substantiated conclusions; - methods of statistical processing, modeling and simulation of processes and systems of physical and biological nature **skills:** - evaluate and analyze the results of the application of statistical methods and criteria; - analyze the results of quantitative assessment of clinical effect and diagnostic tests; to apply in practice algorithms of decision-making on a choice of a method of mathematical statistics; - use databases, mathematical and software for

	data processing of biomedical systems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to interpret the results of the most common methods of functional, instrumental and laboratory diagnostics used to detect diseases.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 26 F-Catalog

Discipline	**Design of medical information systems**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Fundamentals of programming and process modeling
What will be studied	Principles, methods and means of building medical information systems, medical information resources, interaction of medical information systems using new information technologies, skills of design, development, implementation and operation of medical information systems in health care facilities.
Why is it relevant and important	To simplify the work of health care workers by developing medical information systems and implementing business processes in their activities.
What is taught (learning outcomes)	**knowledge:** - basic models and methods of information systems development; - methods of modeling the life cycle of the information system; - basics of business process modeling and development of medical information systems; - basics of software for modeling the life cycle of the information system; **skills:** - to develop algorithms for modeling business processes in medical information systems; - apply methods and algorithms for solving theoretical and applied problems in the field of medical information systems; - to develop complexes of formalization and management of medical information.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to form ideas about methods of informatization of medical staff, automation of clinical trials, informatization of management in the health care system.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua

Form of study	Lectures, practical classes
Semester control	test

Discipline 27 F-Catalog

Discipline	**Multidimensional statistical analysis**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of medical statistics, methods of grouping and analysis of the results
What will be studied	Modeling in biology and medicine using multidimensional statistical analysis, examples of models of biological processes and systems, approaches to research and forecasting of systems, basic approaches to building mathematical models, experimental and statistical modeling.
Why is it relevant and important	The study of complex systems and processes is based on the methods of mathematical modeling and multidimensional statistical analysis. To make optimal management decisions, it is necessary to take into account the complex relationship of various factors influencing the processes.
What is taught (learning outcomes)	**knowledge:** - main tasks and goals of multidimensional statistical analysis; - stages of multidimensional statistical analysis; - multidimensional methods of research of dependences, reduction of dimensionality of space of signs and multidimensional classification of objects; - methods of obtaining estimates of the parameters of multidimensional statistical analysis; - scope of basic models and their limitations in biomedical research **skills:** - collect and process multidimensional data using statistical methods; - adequately set the task of research and optimization of complex objects based on methods of mathematical and statistical modeling; - choose the class of the model and optimize its structure depending on the task, the properties of the simulated object and the conditions of the experiment; - to choose adequate methods of research of models; - to develop models of systems using different

	approaches to the study of systems; - make adequate decisions based on the results of model research; collect, analyze and interpret information in various forms of reporting.
How to apply acquired knowledge and skills (competencies)	Acquired knowledge and skills can be used in research and optimization of biological processes and systems, in the study and prediction of complex systems.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 28 F-Catalog

Discipline	**Laboratory analytical equipment**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of optoelectronic radiation sources, the laws of classical optics, the propagation of electromagnetic waves in biological tissues and media.
What will be studied	Tasks of clinical laboratory diagnostics. The main directions of clinical laboratory diagnostics. Subdivisions of clinical diagnostic laboratories. Equipment for separation of liquid inhomogeneous systems by centrifugation. Chromatography methods. Electrophoresis. Mass spectrometry. Optical methods in laboratory diagnostics. Antigen-antibody interaction. Application of enzyme-linked immunosorbent assay in diagnosis. Equipment for enzyme-linked immunosorbent assay. Immunophenotyping. Flow cytofluorimetry. Biochips and biosensors.
Why is it relevant and important	It is interesting to study the discipline because modern hardware methods of studying human health can prevent the spread of pandemic epidemics.
What is taught (learning outcomes)	**knowledge:** - the main trends and directions of development of medical equipment and the relevant labor market basic methods and tools used to quantify the functioning of physiological systems; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - methods and ways of application of these or those radio-electronic components at service of medical equipment; - basic physical and physico-chemical laws of functioning of biological objects. **skills:** - to find similarities and differences of functional systems of the human body and engineering devices and automatic systems; - to use methods and means of quantitative assessment of the functioning of physiological

	systems in practical engineering activities; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to form and substantiate medical and technical requirements for medical devices; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to improve the technical elements of medical devices and systems and medical devices in the process of professional activity; - apply methods and tools for forecasting and modeling to study the behavior and properties of biological systems
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and competencies can be used for the design and development, as well as the operation of modern laboratory equipment to determine previous pathological changes in the human body.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 29 F-Catalog

Discipline	**Modern optoelectronic diagnostic devices**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Basic knowledge of general physics and the laws of propagation and interaction of optical radiation with biological objects, basics of physiological characteristics and parameters of biological tissues and organs.
What will be studied	The main characteristics of the formed elements of blood. Basic principles implemented in hematology analyzers. Their structure and software. Classes of hematological analyzers. VCS principle. Flow cytofluorimetry. Semi-automatic and automatic optoelectronic methods. Laboratory laser analytical systems. The main characteristics of laser radiation sources for medical use. The use of modern fiber-optic optical fibers for the design of diagnostic devices.
Why is it relevant and important	It is interesting to study the discipline because you can get relevant information about the development, operation and repair of modern laboratory diagnostic equipment.
What is taught (learning outcomes)	**knowledge:** - fundamental-applied, medical-physical and bioengineering bases technologies and equipment for the study of human body processes; - means of designing devices, devices and systems for medical and biological purposes; - research methods and techniques used in design medical equipment; - methods of object research, analysis and processing of experimental data; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - the main methods and tools used for quantification functioning of physiological systems. **skills:** - formulate logical conclusions and sound recommendations for evaluation, operation and implementation of biotechnical,

	medical-technical and bioengineering means and methods; - be able to use databases, mathematical and software for data processing and computer modeling of biotechnical systems; - provide engineering support, service and other maintenance during operation of laboratory-analytical equipment, medical diagnostic and therapeutic complexes and systems, as well as draw up standard documentation by types of work in accordance with the Technical Regulations for medical devices; - be able to analyze the signals transmitted from the organs to the devices, and to process diagnostic information.
How to apply acquired knowledge and skills (competencies)	Acquired knowledge and skills (competencies) can be used for operation, development and conduct of laboratory research of modern laser and microcontroller diagnostic medical equipment.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 30 F-Catalog

Discipline	**Fundamentals of laser laboratory methods of biomedical research**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of quantum physics and medicine, the principle of operation of coherent emitters, the laws of refraction and scattering, the basics of classical optics, knowledge of the basic biophysical parameters of biological objects.
What will be studied	Methods for determining the size, shape and structure of dispersed particles of biological objects. Methods for measuring scattering indicators and intra-polarization characteristics of cells and blood cells. Methods for determining the quantitative composition of the curtain in a dispersed medium of biological solutions. Types of interaction of laser radiation with biological objects. Methods of laser spectroscopy (Raman spectroscopy, absorption and colorimetric spectroscopy, laser fluorescence analysis, laser mass spectroscopy).
Why is it relevant and important	It is interesting to study the discipline because modern hardware methods of studying human health can prevent the widespread spread of pandemic epidemics, in particular related to changes in the biophysical properties of biological objects
What is taught (learning outcomes)	**knowledge:** - the main trends and directions of development of medical equipment and the relevant labor market basic methods and tools used to quantify the functioning of physiological systems; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - methods and ways of application of these or those radio-electronic components at service of medical equipment; - basic physical and physico-chemical laws of functioning of biological objects. **skills:** - to find similarities and differences of functional systems of the human body and engineering devices and automatic systems; - to use methods and means of quantitative

	assessment of the functioning of physiological systems in practical engineering activities; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to form and substantiate medical and technical requirements for medical devices; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to improve the technical elements of medical devices and systems and medical devices in the process of professional activity; - apply methods and tools for forecasting and modeling to study the behavior and properties of biological systems
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and competencies can be used for modern laboratory research of pathological changes in the human body, design, development, repair and operation of modern diagnostic laboratory equipment.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 31 F-Catalog

Discipline	**Theory of inventive problem solving**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the historical course of development of science and technology.
What will be studied	Methods of developing creative imagination and activating the solution of technical problems, differences between problem and problem, principles of problem statement and formulation, which helps to identify the essence of the problem and correctly determine the main directions of search, how to systematize information retrieval, principles of logical and systematic thinking. technical, informational, biological and others, the laws of development of technical systems, the algorithm for solving inventive problems, the basic principles of application of the theory in technical and non-technical fields.
Why is it relevant and important	The discipline forms a systematic approach that significantly increases the efficiency of creative work and develops engineering thinking and approaches to the study of medical and biological objects.
What is taught (learning outcomes)	**knowledge:** practical methods of organization and solution of engineering problems of different levels of complexity ethical standards for engineering activities principles of information systematization main trends and directions of development of medical equipment and the relevant labor market **skills:** think systematically to develop and apply creative abilities in professional activity apply knowledge of fundamental disciplines to solve professional problems apply and accept criticism, including self-criticism argued to defend his opinion analyze the current state and technological features of medical instrument making and biomedical engineering

How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to organize autonomous and collective activities, identify promising areas of technology and reduce time to solve problems related to the development, research, improvement, modeling of devices and systems.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 32 F-Catalog

Discipline	**Algorithms for solving practical problems of science and technology**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the historical course of development of science and technology.
What will be studied	Methods of developing creative imagination and activating the solution of technical problems, differences between problem and problem, principles of problem statement and formulation, which helps to identify the essence of the problem and correctly determine the main directions of search, how to systematize information retrieval, principles of logical and systematic thinking. technical, informational, biological and others, the laws of development of technical systems, the algorithm for solving inventive problems, the basic principles of application of the theory in technical and non-technical fields.
Why is it relevant and important	The discipline forms a systematic approach that significantly increases the efficiency of creative work and develops engineering thinking and approaches to the study of medical and biological objects.
What is taught (learning outcomes)	**knowledge:** - practical methods of organization and solution of engineering problems of different levels of complexity; - ethical standards for engineering activities; - principles of systematization of information; - the main trends and directions of development of medical equipment and the relevant labor market **skills:** - think systematically; - to develop and apply creative abilities in professional activity; - apply knowledge of fundamental disciplines to solve professional problems apply and accept criticism, including self-criticism; - to defend his opinion with arguments; - to analyze the current state and technological

	features of medical instrument making and biomedical engineering.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to organize autonomous and collective activities, identify promising areas of technology and reduce time to solve problems related to the development, research, improvement, modeling of devices and systems.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 33 F-Catalog

Discipline	**Biopharmaceutical engineering**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Department of translational medical bioengineering
Entry requirements	Knowledge of the basics of higher mathematics, anatomy, physiology, biochemistry, biophysics, basics of biomedical engineering, laboratory analytical techniques, medical statistics.
What will be studied	Medical-biological, physico-chemical, engineering-technological and technical-economic aspects of creation of medical, diagnostic and prophylactic drugs of biological origin.
Why is it relevant and important	Specialists in biomedical engineering, in particular those specializing in biopharmaceutical technologies, need knowledge and skills that allow: - understand the fundamental and applied bases of development and testing of biological products for medical purposes (innovative biological products, biosimilars, bioimplants, medical devices for in vitro diagnostics, other medical devices of biological origin); - to carry out medical-biological, technical-economic assessment of technologies of bioproducts of medical appointment; - - to offer optimal engineering solutions for the implementation of new or improvement of existing technologies of biological products for medical purposes.
What is taught (learning outcomes)	**knowledge:** - fundamental and applied bases of development and testing of biological products for medical purposes (innovative biological products, biosimilars, bioimplants, medical devices for in vitro diagnostics, other medical products of biological origin); - methodology of medical-biological and technical-economic assessment of technologies of biological products for medical purposes; - basic engineering techniques for the design of new and improvement of existing technologies of biological products for medical purposes; - narrowly specialized national and international

	regulatory framework for the creation, evaluation and use of technologies for biomedical products. **skills:** - to analyze methods of development and testing of bioproducts for medical purposes from the standpoint of their medical-diagnostic, pharmacoeconomic efficiency; - apply the norms of international and national legislation for the creation, evaluation and use of technologies of bioproducts for medical purposes; - independently design production sites specializing in the manufacture of biological products for medical purposes.
How to apply acquired knowledge and skills (competencies)	Acquired knowledge and skills (in general - competencies) are a tool for the implementation of the following functions by specialists in biomedical engineering: - creation and testing of new or improvement of existing technologies of bioproducts for medical purposes (research and engineering activities); - assessment of compliance of medical biotechnology technologies with national and international standards (regulatory and certification activities).
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 34 F-Catalog

Discipline	**Therapeutic medical equipment**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of human anatomy and physiology, basic knowledge of general physics and characteristics of electric and magnetic fields, propagation of electromagnetic oscillations.
What will be studied	General concepts of medical equipment Tasks of clinical medical equipment. The main directions of clinical medical equipment. Subdivisions of modern therapeutic devices. Apparatus for low-frequency magnetic field therapy. General purpose equipment. Equipment and methods of application of low-magnetic field therapy. Apparatus for woofer magnetic therapy "Pole 1". Apparatus for therapy with direct electric current and field. Features of protocols of general procedures of physiotherapy. The effect of aeroionotherapy. Apparatus for electroaerosol therapy. Electroaerosol generator on the principle of injection. The principle of operation of the generator. Features of the schematic diagram. Medical methods of application of the generator of electroaerosols The main characteristics of RF therapy equipment Physical bases of action of RF oscillations on body tissues. Basic methods of applying RF oscillations. Features of diathermy and RF electrosurgery. Darsonvalization and physiotherapy. Features of devices for current therapy above the tonal frequency. Apparatus for UHF and microwave therapy. Features of pulsed and continuous UHF and microwave devices. Medical applications of DMH and SMH therapeutic devices. Ultrasound therapeutic and rehabilitation equipment. Design features of the ultrasonic emitter. The effect of ultrasound oscillations on the

	microstructure of biological tissues and human organs. Therapeutic and diagnostic complex for rehabilitation. Adjustment of the immune system of the human body by hardware. Modern devices for rehabilitation of human diseases.
Why is it relevant and important	It is interesting to study to use the knowledge of the work and features of the design and repair of a wide class of medical equipment used in sanatorium-rehabilitation medical institutions.
What is taught (learning outcomes)	**knowledge:** - the main trends and directions of development of medical equipment and the relevant labor market; - the main methods and tools used to quantify the functioning of physiological systems; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - methods and ways of application of these or those radio-electronic components at service of medical equipment; - basic physical and physico-chemical laws of functioning of biological objects. **skills:** - to find similarities and differences of functional systems of the human body and engineering devices and automatic systems; - to use methods and means of quantitative assessment of the functioning of physiological systems in practical engineering activities; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to form and substantiate medical and technical requirements for medical devices; - to implement modern diagnostic and treatment methods related to the use of biotechnology, computer and nanotechnology - to improve the technical elements of medical devices and systems and medical devices in the process of professional activity; - apply methods and tools for forecasting and modeling to study the behavior and properties of biological systems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills (competencies) can be used when working with modern medical equipment, to modernize, maintain and repair it.
Information resources	Educational and working programs of the

	discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 35 F-Catalog

Discipline	**Development and operation of physiotherapeutic medical devices**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of the propagation of electromagnetic radiation in different environments, biochemical features of the functioning of internal organs and the human body as a whole.
What will be studied	General concepts of features of medical equipment for further action in diseases of the cardiovascular system of the human body, basic terms and definitions. Electronic devices of therapy in medical equipment and their classification. The main tasks of design and requirements for modern medical equipment. Different distributions of therapeutic equipment by functional complexity. Features of protocols of general procedures of physiotherapy. The effect of aeroionotherapy. Apparatus for electroaerosol therapy. The main modern ways of influencing the electric field on the human body and the heart. Apparatus of therapy in inpatient and outpatient settings, indication and transmission of information during visualization and registration, the main criteria for choosing the type of transmission of information. Adjustment of the immune system of the human body by hardware. Modern devices for rehabilitation of human diseases. Features of rehabilitation by means of infrared and visible irradiation of skin and blood of the person. The principle of operation and main characteristics of modern laser medical and diagnostic complexes for rehabilitation.
Why is it relevant and important	This is interesting and should be studied because modern medical rehabilitation equipment makes extensive use of the latest advances in laser technology, microcomputer nanoelectronics.
What is taught (learning outcomes)	**knowledge:** - universal principles of structure of complex biological systems, including the human body; - methods of statistical processing, modeling and simulation of processes and

	systems of physical and biological nature; - the main methods and tools used for quantification functioning of physiological systems; - methods of application of signal theory and methods of signal research and images in the specialty of biomedical engineering; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - means of designing devices, devices and systems for medical and biological purposes; - research methods and techniques used in design medical equipment. **skills:** - to develop and implement modern diagnostic and treatment methods, related to the use of biotechnology, computer and nanotechnology; - use computer-aided design systems for development technological and hardware scheme of medical devices and systems; - select and recommend appropriate medical equipment and biomaterials to equip medical facilities and provide basic stages of the technological process of diagnosis, prevention and treatment; - provide recommendations on the choice of equipment to ensure the conduct diagnosis and treatment; - provide engineering support, service and other maintenance during operation of laboratory-analytical equipment, medical diagnostic and therapeutic complexes and systems, as well as draw up standard documentation by types of work in accordance with the Technical Regulations for medical devices; - use databases, math and software for data processing and computer modeling of biotechnical systems.
How to apply acquired knowledge and skills (competencies)	Acquired knowledge and skills (competencies) can be used when working with modern medical laser physiotherapy equipment, to carry out its modernization, maintenance and repair.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works

	URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 36 F-Catalog

Discipline	**Therapeutic and diagnostic complexes based on biophotonic converters**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the anatomical structure of the human body, the basics of electrical signal propagation in biological objects, the basics of optical and quantum physics, the basics of cytology, histology and biophysics, the principle of formation of human biopotentials, characteristics of biologically active points.
What will be studied	Universal automated medical and diagnostic devices and systems based on laser and ultrasound methods of studying the physiological state of man (simultaneous measurement of gas exchange, heart rate, electrocardiogram and electroencephalogram, blood pressure, temperature, etc.). Features of use of modern biophotonic converters of the basic biomechanical and bioacoustic sizes of displays of vital activity of a human body.
Why is it relevant and important	This is interesting and should be studied because the effective treatment of many diseases requires prior highly informative diagnosis using the latest equipment and techniques for measuring pathological changes in biological objects with modern high-precision transducers, followed by treatment protocols to compensate for these transformations.
What is taught (learning outcomes)	**knowledge:** - universal principles of structure of complex biological systems, including the human body; - methods of statistical processing, modeling and simulation of processes and systems of physical and biological nature; - the main methods and tools used to quantify the functioning of physiological systems; - methods of application of signal theory and methods of research of signals and images in the specialty of biomedical engineering; - basic operating conditions of diagnostic and therapeutic systems, medical complexes and systems; - means of designing devices, devices and systems for medical and biological purposes; - methods and research methods used in the

	design of medical equipment. **skills:** - to develop and implement modern diagnostic and treatment methods, related to the use of biotechnology, computer and nanotechnology; - use computer-aided design systems to develop a technological and hardware scheme of medical devices and systems; - select and recommend appropriate medical equipment and biomaterials for equipping medical institutions and ensuring the main stages of the technological process of diagnosis, prevention and treatment; - provide recommendations on the choice of equipment to ensure diagnosis and treatment; - carry out engineering support, service and other maintenance during the operation of laboratory and analytical equipment, medical diagnostic and therapeutic complexes and systems, as well as draw up standard documentation for the types of work in accordance with the technical regulations for medical devices; - use databases, mathematical and software for data processing and computer modeling of biotechnical systems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and competencies can be used when working in modern high-tech medical laboratories, to carry out effective operation of equipment, its preventive maintenance and repair.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 37 F-Catalog

Discipline	**Methods and means of diagnosing human pathology**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Fundamentals of medical devices, basics of anatomy and physiology, analysis, collection and processing of medical information
What will be studied	Methods and tools of research using medical equipment and computer technology for human examination
Why is it relevant and important	An urgent task is the development and implementation of new medical technologies, in particular, diagnostic systems and complexes that increase the efficiency of the treatment and diagnostic process.
What is taught (learning outcomes)	**knowledge:** - instrumental methods of research of various functional systems of a human body; - general principles and basic methods of instrumental diagnosis of the functional state of organs and systems of the human body; - equipping the functional diagnostics service; **skills:** - evaluation of the results of the study of the functional systems of the human body; - determining the reliability of the received diagnostic information; - perform, interpret and analyze the results of diagnostic tests; - to apply methods of functional research for diagnostics of a human body.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used in the dynamic monitoring of data from functional studies of patients, in the organization of the functional diagnostic service, in the hardware of the functional diagnostic service.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 38 F-Catalog

Discipline	**Quality management system in medicine**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Fundamentals of medical documentation development
What will be studied	Theoretical and methodological issues of quality management, quality control and management tools, development, implementation and certification of quality management systems, principles of auditing these systems in accordance with national and international quality standards.
Why is it relevant and important	To evaluate the performance of a health care facility.
What is taught (learning outcomes)	**knowledge:** - basic concepts of the quality of medical care and the activities of the health care institution in general; - current problems of assessment and quality control of medical care to the population and their impact on changes in health care; - ensuring the quality of medical care at different levels of the diagnostic process, use of resources, performance of professional functions; - methods for assessing the quality of medical care at different levels of its provision; **skills:** - have the organizational basis of health care facilities on the basis of international quality standards, the basic principles of standardization in health care; - to determine the value of indicators of quality of medical care, performance indicators of the health care institution (structure, process, results); - measure the quality of medical care using indicators of quality of medical care; - draw up a plan of activities of the health care institution based on the values of indicators of the quality of medical care.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used for drawing up plans of preventive measures on the basis of the analysis of indicators of activity of medical institutions, expert estimations in

	system of quality control of medical care, values of indicators of quality of medical care.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 39 F-Catalog

Discipline	**Functional diagnostics**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Fundamentals of medical devices, basics of anatomy and physiology, analysis, collection and processing of medical information
What will be studied	Methods of conducting the main types of functional diagnostics, principles of evaluation of the results obtained with the help of the studied methods of functional diagnostics in the study of physiological processes and functions of the body of a healthy person.
Why is it relevant and important	In modern conditions, the task of developing and implementing new medical technologies, including diagnostic systems and complexes, which increase the efficiency of the medical-diagnostic process and reduce economic and labor losses, becomes urgent. In this regard, the role and importance of functional research methods, which are widely used for early detection of pathology, differential diagnosis of various diseases and monitoring the effectiveness of treatment and rehabilitation measures.
What is taught (learning outcomes)	**knowledge:** - basic methods of functional diagnostics; - physiological bases, varieties, diagnostic possibilities of the studied methods of functional diagnostics; - basic norms and recommended values, principles of evaluation of indicators of methods of functional diagnostics; - the importance of using methods of functional diagnostics in the study of physiological processes and features of the human body; - basic devices for functional diagnostics; - basic concepts and terms used in functional diagnostics. **skills:** - to explain the importance of the studied methods of functional diagnosis in understanding the function of the organism; - to be guided in the basic terminology of functional diagnostics; use the results of methods of functional diagnostics to assess and study the functions of organ systems and the basic physiological

	processes of a healthy human body.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be used to organize and manage the activities of medical diagnostic centers and departments, to organize a functional diagnostic service, to verify the correct operation of medical devices.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 40 F-Catalog

Discipline	**Technology for building software products**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of computer science, object-oriented programming, software
What will be studied	Accumulated experience and standards in the field of design, construction, testing, configuration, implementation and maintenance of software systems, selection of optimal solutions based on modern technologies; software component development; implementation of software architecture prototypes; application of special knowledge in the field of informatics and computer engineering to solve interdisciplinary engineering problems
Why is it relevant and important	The IT industry is developing the fastest in Ukraine (and in the world). The need for relevant specialists is growing every year. But to find your place, you need to know the common technologies and tools, tools for designing and developing software systems. The same applies to developments in biomedical engineering, as it is now difficult to imagine biomedical devices and systems without some software. In addition, it is very useful to use these technologies and standards in diploma design.
What is taught (learning outcomes)	**knowledge:** - modern programming technologies and tools that support their use; - basic tools and methods of visual programming, basic technological methods of developing fault-tolerant and flexible to change software systems; - the main tools of CASE-tools; - software development life cycle models; - basic measures for the organization of the software development process; - principles of software systems design; - modern trends in the development of computer science and computer technology, computer technology in biomedicine; - bases of creation of information systems and use of new information technologies of information processing, in particular, medico-biological nature; - elements of complexity theory. **skills:**

	- use databases, mathematical and software for data processing and computer modeling of biotechnical systems; - to make tasks for the development of automated control systems taking into account the capabilities of modern hardware and software automation of medical equipment; - create programs in the development environment of laboratory virtual instruments NI LabVIEW; - analyze the task and select such tools that will best organize the work of the software system; - to carry out the process of designing a software system; - apply mathematical methods, physical laws, biomedical data and computer technology to solve practical problems.
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be applied in the creation of any software - from the installation of a modern biomedical device to work in a professional IT-group, where the use of common terminology, technologies, standards is of particular importance.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 41 F-Catalog

Discipline	**Web-based software development**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of computer science, object-oriented programming, software
What will be studied	Internet services. Web structure and principles Internet protocols. Domain zones, IDN. Web servers and web clients. Creating an object structure of site pages using HTML Features and benefits of modern HTML5 technology. Implementation of the principle of separation of object structure and site design in CSS technology. Features and benefits of modern CSS3 technology. The language of description of CML schemes and its application in web technologies. Formatting and converting CML documents using HSL. Client scenarios. JavaScript is the basis of typical client scripting technology. jQuery is an example of the fruitful use of object-oriented programming technology in web applications. Server scripts. PHP is the basis of typical server-side scripting technology Technologies of interaction with databases in server-side scenarios. MySQL. Use of Java language in web applications. Java applets Implementation of the principles of separation of structure, design and content of the site in CMS technology Common in the web environment varieties of CMS. Basic principles of CMS WordPress and Joomla application. Implementation of asynchronous browser interaction with a web server using AJAX technology
Why is it relevant and important	According to statistics, the need for web specialization specialists is growing in the IT industry. This is due to the growing transition to virtual communication in all areas: from regular sites of organizations and individuals to the Internet of Things. If a job applicant in the resume can indicate their mastery of site creation technologies and demonstrate a portfolio of their sites, it significantly increases his rating. Web technologies are also widely used in biomedical

	engineering. The most striking example is telemedicine, which is now considered a priority in government programs.
What is taught (learning outcomes)	**knowledge:** - modern programming technologies and tools that support their use; - basic methods and tools for designing and developing website software, including client and server scenarios, methods of rapid website development using CMS (content management system); - modern object-oriented algorithmic languages used in the web; - server technologies for creating web applications, the ability to use methods and tools for their design; **skills:** - to develop web applications of various complexity on the basis of optimal use of modern technologies; apply the basic models, methods and tools of information technology and methods of their use - to solve problems in subject areas, object-oriented methods and tools for developing algorithms and programs, modern ready-made libraries of modules, system software and technologies; design software components
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be applied in the development and use of virtual communication tools - from websites of individuals and organizations to the Internet of Things and web technologies in biomedicine, such as telemedicine.
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test

Discipline 42 F-Catalog

Discipline	**Web-technology and web-design**
Level of higher education	First (Bachelor`s)
Course	4
Scope	4 ECTS
Language of instruction	English
Department	Biomedical engineering
Entry requirements	Knowledge of the basics of computer science, object-oriented programming, software
What will be studied	Internet services. Web structure and principles Internet protocols. Domain zones, IDN. Web servers and web clients. Creating an object structure of site pages using HTML. Features and benefits of modern HTML5 technology. Implementation of the principle of separation of object structure and site design in CSS technology. Features and benefits of modern CSS3 technology. The language of description of CML schemes and its application in web technologies. Formatting and converting CML documents using HSL. Client scenarios. JavaScript is the basis of typical client scripting technology. jQuery is an example of the fruitful use of object-oriented programming technology in web applications. The emphasis in the study of this discipline is on the general principles of construction and operation of the Internet and web services, designing the object structure of sites and their design, the client part (front-end).
Why is it relevant and important	According to statistics, the need for web specialization specialists is growing in the IT industry. This is due to the growing transition to virtual communication in all areas: from regular sites of organizations and individuals to the Internet of Things. If a job applicant in the resume can indicate their mastery of site creation technologies and demonstrate a portfolio of their sites, it significantly increases his rating. Web technologies are also widely used in biomedical engineering. The most striking example is telemedicine, which is now considered a priority in government programs.
What is taught (learning outcomes)	**knowledge:** - modern programming technologies and tools that support their use; - basic methods and tools for designing and developing website software, including client and server scenarios, methods of rapid website development using CMS (content management system);

	- modern object-oriented algorithmic languages used in the web; - server technologies for creating web applications, the ability to use methods and tools for their design; **skills:** - to develop web applications of various complexity on the basis of optimal use of modern technologies; apply the basic models, methods and tools of information technology and methods of their use - to solve problems in subject areas, object-oriented methods and tools for developing algorithms and programs, modern ready-made libraries of modules, system software and technologies; design software components
How to apply acquired knowledge and skills (competencies)	The acquired knowledge and skills can be applied in the development and use of virtual communication tools - from sites of individuals and organizations to the Internet of Things and web technologies in biomedicine, such as telemedicine
Information resources	Educational and working programs of the discipline, RSE, textbook (electronic edition), syllabus, online course on Moodle, practical classes, laboratory works URL: https://do.ipo.kpi.ua
Form of study	Lectures, practical classes
Semester control	test