FEDERAL STATE BUDGETARY
EDUCATIONAL INSTITUTION OF HIGHER EDUCATION
«AMUR STATE MEDICAL ACADEMY»
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION

AGREED
Vice-Rector for Academic Affairs,

_____N.V. Loskutova

April 17, 2025

Decision of the CCMC
April 17, 2025

Protocol No. 7

APPROVED
by decision of the Academic Council of the FSBEI HE Amur SMA of the Ministry of Health of the Russian Federation
April 22, 2025

Protocol No. 15

Acting Rector of the FSBEI HE Amur SMA of the Ministry of Health of the Russian Federation

_____I.V. Zhukovets

April 22, 2025

ДОКУМЕНТ ПОДПИСАН
ЭЛЕКТРОННОЙ ПОДПИСЬЮ

Сертификат: 50AB2242604E64520B52614FA420034A
Владелец: Жуковец Ирина Валентиновна
Действителен: с 15.04.2025 до 09.07.2026

EDUCATIONAL PROGRAM

disciplines «Physics, Mathematics»

Specialty: 31.05.01 General Medicine
Course: 1
Semester: 1
Total hours: 108 hrs.
Total credits: 3 credit units
Control form: credit-test, 1 semester

Blagoveshchensk, 2025

2

The educational program of the discipline is designed in accordance with the requirements of the Federal State Educational Standard of Higher Education - specialist in specialty 31.05.01 General Medicine, approved by the order of the Ministry of Education and Science of Russia dated 08.12.2020 No. 988 (registered with the Ministry of Justice of Russia on 08.26.2020 No. 59493), BPEP HE (2021).

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Reviewers:

Head of the Department of Physiology and Pathophysiology of the Federal State Budgetary Educational Institution of Higher Education Amur State Medical Academy, Holder of an Advanced Doctorate (Doctor of Science) in Biological Sciences, Ph.D. of Chemical Sciences, Associate Professor, T.A. Batalova

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APPROVED at the meeting of the Department of Medical Physics,
Protocol No. 12 dated April 15, 2025

Head of Department,
Ph.D. of Pedagogic Sciences, Associate Professor _____ **E.V. Plashchevaya**

Conclusion of the Expert Commission on the review of the Educational Programs:
Protocol No. 2 dated April 16, 2025

Expert of the expert commission,
Ph.D. of Engineering Sciences _____ **E.A. Utochkina**

APPROVED at the meeting of the Cycle Methodical Committee No. 1: Protocol No. 7 dated April 16, 2025.

Chairman of the CMC No. 1
Holder of the Advanced Doctorate (Doctor of Sciences)
in Medical Sciences, Professor _____ **E.A. Borodin**

AGREED: Dean of the Faculty of Medicine,
Ph.D. of Medical Sciences _____ **N.G. Brush**

April 17, 2025

CONTENT

1. EXPLANATORY NOTE

1.1. Characteristics of the discipline

Physics and mathematics are two fields that constantly surround us in everyday life. Every day, the influence of physics on the development of medicine only increases, and the medical industry is modernized due to this. The use of physics in medicine is undeniable. In fact, every tool used by doctors, from a scalpel to the most complex devices for establishing an accurate diagnosis, functions or is made thanks to the achievements in the world of physics. It is worth noting that physics has always played an important role in medicine.

The features of studying the disciplines «Physics, Mathematics» are: the interdependence between the goals of physical and medical education; the universal and fundamental nature of the course; the peculiarity of their content construction due to the nature and general goals of training of a doctor and his specialization; the unity of studying biophysical objects both gross and microscopic with the disclosure of different forms of their physical organization as a single system and the different functions it exhibits depending on their nature, environment and conditions.

1.2. Goal and objectives of the discipline.

The goal of teaching the discipline:

- developing students' systematic knowledge of the physical properties and physical processes occurring in biological objects, including the human body, which is necessary for mastering other academic disciplines and developing professional medical qualities;
- development of theoretical knowledge and practical skills in the use of mathematical apparatus and statistical methods in evidence-based medicine;
- developing logical thinking in students based on the natural scientific nature of the material being studied.

Educational objectives of the discipline:

- the study of general physical laws underlying the processes occurring in the body;
- developing students' logical thinking, the ability to accurately formulate problems, and the ability to distinguish between the main and the secondary;
- students acquire the ability to draw conclusions based on the obtained measurement results;
- study of sections of applied physics that examine the principles of operation and capabilities of medical equipment used in diagnostics and treatment (medical physics);
- study of elements of biophysics: physical phenomena in biological systems, physical properties of these systems, physical and chemical foundations of life processes;
- teaching students' methods of mathematical statistics that are used in medicine and allow extracting the necessary information from the results of observations and measurements, and assessing the degree of reliability of the data obtained;
- developing students' skills in using application software packages for statistical processing of medical and biological information;
- development of skills for studying scientific literature;
- teaching student's safety precautions when working with medical equipment.

1.3. The place of the discipline in the structure of the main professional educational program of higher education.

In accordance with the Federal State Educational Standard of Higher Education - specialist in specialty 31.05.01 General Medicine (2020), the discipline «Physics, Mathematics» refers to the disciplines of the basic part, Block 1. The total workload is 3 credit units (108 hours), is taught in the 1st semester in the 1st year. Control form - credit.

Students are instructed on the principle of consistent knowledge and skills acquired in the secondary school course of physics and mathematics. To master the discipline «Physics, Mathematics» theoretical knowledge and skills in mathematics and physics, practical computer literacy skills in the volume provided by the secondary school program are required.

The discipline «Physics, Mathematics» is a subject necessary for studying specialized disciplines that are taught in parallel with this subject or in subsequent years. Mastering the discipline «Physics, Mathematics» precedes the study of: normal physiology, pathophysiology, clinical pathophysiology; biochemistry; histology, embryology, cytology; hygiene; microbiology and virology; public health and healthcare; neurology; otolaryngology; ophthalmology, radiation diagnostics and radiation therapy; infectious diseases and other clinical disciplines.

The discipline «Physics, Mathematics» consists of 2 modules, which present the most important and necessary information that determines the educational process:

Module 1: Mathematics.

Module 2: Physics.

1.4 Requirements for students

To master the discipline «Physics, Mathematics», a student must possess the necessary knowledge, skills and abilities developed in institutions of secondary (complete) general education:

Mathematics
Knowledge: of fundamentals of mathematical analysis, statistics and probability theory; algebraic operations, logarithmic and power functions.
Abilities:toperform calculations using mathematical formulas, calculate derivatives and antiderivatives of elementary functions.
Skills: towork with mathematical apparatus and computer technology to perform calculations using formulas, perform statistical processing of experimental results.
Physics
Knowledge: of fundamental physical concepts; physical quantities and units of measurement; basic theories of classical and modern physics; basic laws and principles on which modern devices operate.
Abilities: work with the simplest devices, instruments and circuits that are used in physics laboratories, understand the principles of their operation; guide in modern and newly designed technology with the aim of its rapid mastery, implementation and effective use in practical activities.
Skills: work with mathematical apparatus and computer technology to calculate physical quantities that characterize the behavior of substances, makesimple assessments and calculations to analyze physical phenomena and the impact of various physical factors on the human body.
Biology
Knowledge:the nature of biological processes, the most important substances involved in the structure and activity of a living organism.
Abilities: traces the connection between biological and physical processes occurring in nature and living organisms.

Skills: searching for necessary information on the physical and biological role of substances using computer technology.

1.5 Interdisciplinary links with subsequent disciplines

Knowledge, skills and abilities necessary for studying subsequent disciplines:

No. p/p	Name of subsequent disciplines	Numbers of discipline modules required for studying subsequent disciplines	
		1	2
1	Biochemistry	+	+
2	Normal Physiology	+	+
3	Pathophysiology, clinical pathophysiology	+	+
4	Pharmacology	+	+
5	Hygiene	+	+
6	Propaedeutics of internal diseases, radiation diagnostics	+	+
7	Histology, embryology, cytology	+	+
8	Hospital therapy	+	+
9	Faculty surgery, urology	+	+
10	Otorhinolaryngology	+	+
11	Ophthalmology	+	+
12	Microbiology, virology	+	+
13	Neurology	+	+
14	Public Health and Healthcare	+	+
15	Infectious diseases	+	+

1. 6 Requirements for the results of mastering the discipline

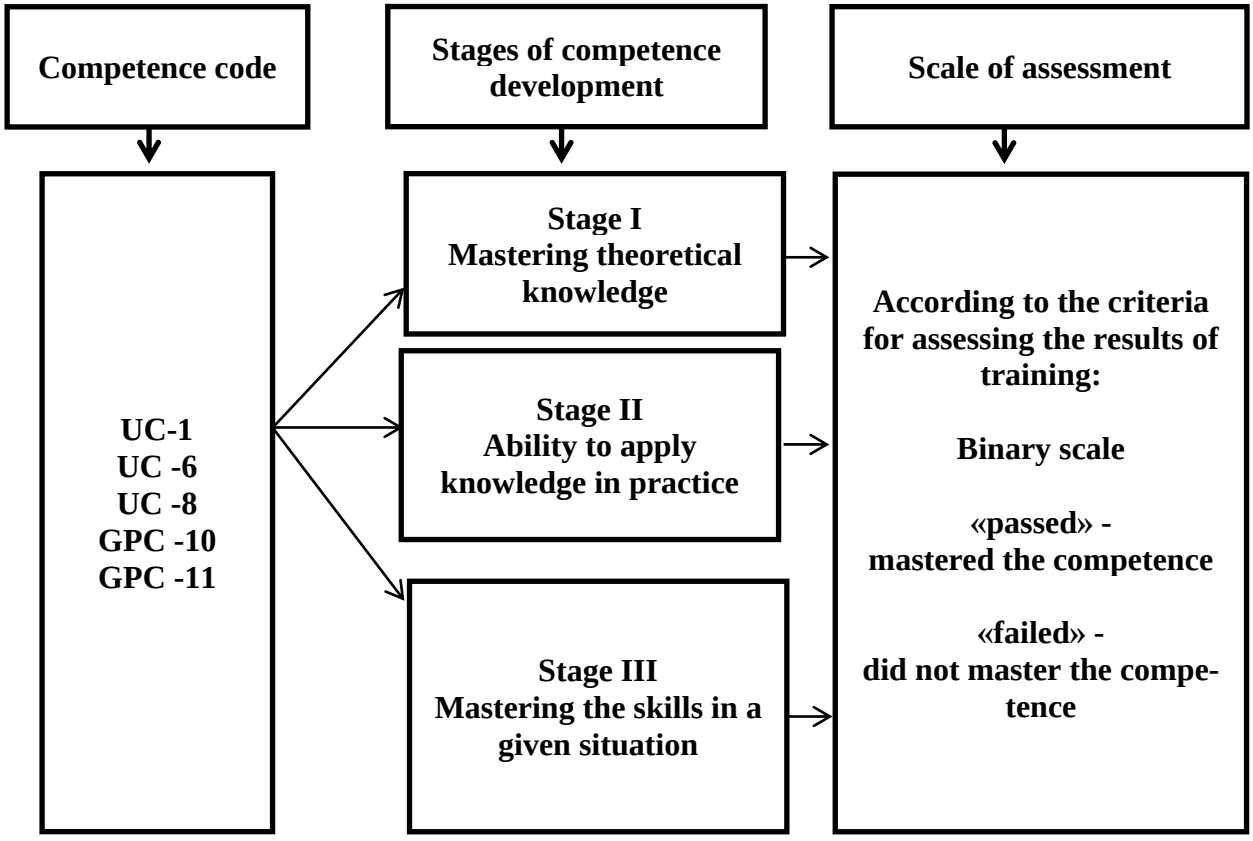
The study of the disciplines«Physics, Mathematics» is aimed at the formation of the following competencies: universal (UC-1, 6, 8) and general professional (GPC-10, 11).

No. p/p	Code and name of competence	Codeand the name of the indicator of achievement of competence
Universal Competencies		
1	**UC-1.** Capable to carry out a critical analysis of problematic situations based on a systems approach, developing an action strategy	**AI UC-1.1.** Analyze the problem situation as a system, identifying its components and the connections between them. **AI UC-1.2.**Identifie gaps in information needed to solve problem situations and design processes to eliminate them. **AI UC-1.3.** Applies systems analysis to resolve problematic situations in the professional sphere.
	UC-6. Capable to define and implement priorities of self-activity and ways of its improvement based on self-assessment and education throughout life	**AI UC-6.1.** Assesses his/her personal, situational, and time resources and uses them optimally to complete the assigned task. **AI UC-6.3.** Conducts critical self-analysis of the results of one's own activities.
	UC-8. Capable of creating and maintaining safe living conditions in everyday life and professional activities to preserve the natural environment, ensure sustainable development of society, including in the event of a threat or occurrence of emergency situations and military conflicts	**AI UC-8.4.** Possesses skills for safe work in chemical, physical, biological laboratories and the ability to handle caustic, poisonous, volatile organic compounds, work with burners, spirit lamps and electric heating devices, animals.
General Professional Competencies		
2	**GPC-10.** Capable of solving standard tasks of professional activity using information, bibliographic resources, medical and biological terminology, information and communication technologies, taking into account the basic requirements of information security	**AI GPC-10.2.** Makes effective search of information needed for solving problems of professional activity, using legal reference systems and professional pharmaceutical databases.
	GPC-11. Capable of preparing and applying scientific, scientific-production, design, organizational-managerial and regulatory documentation in the healthcare system	**AI GPC 11.3.** Interprets and applies data from physical, chemical, mathematical and other natural sciencesconcepts and methods for solving professional problems. **AI GPC-11.4.** Conducts scientific and practical research, analyzes information using the historical method and prepares publications based on the results of research.

Modules of the discipline and the code of the competence being formed

Item No.	Section name	Code of the competence being formed
1	Mathematics.	UC-1, UC-6, UC-8, GPC-10, GPC-11
2	Physics.	UC-1, UC-6, UC-8, GPC-10, GPC-11

1.7 Stages of competencies development and description of assessment scales



1.8 Forms of training organization and types of control

Form of organization of students' training	Briefcharacteristic
Lectures	Lecturematerialcontains key andmostproblematicquestions of disciplines, mostsignificant in preparation of a specialist.
Practical classes	Intended foranalysis (consolidation) of theoreticalprovisionsandcontrolovertheirassimilationwithsubsequentapplication of receivedknowledge during the study of the topic.
Interactive forms of education	- solve the situationaltasks and exercises followed bydiscussion, - interactive survey; - creativetasks implementation, - small group method, - discussions,

	- online course of the discipline in the Moodle system, - testing in the Moodle system.
Participation in the department's research work, student scientific circle and conferences	- preparation of oral reportesand poster presentations for delivering at a student club or scientific conference; - writing thetheses and abstracts in the chosen scientific field; - preparation of a literature review using educational, scientific, reference literature andInternet sources.
Types of control	**Brief description**
Entrance control	Testing of theoretical knowledge and practical skills developed by the physics program in secondary (complete) general education institutions. The entrance control of knowledge includes: - testing in the Moodle system (test tasks for entrance control), - solving situational tasks and exercises. The results of the entrance control are systematized, analyzed and used by the teaching staff of the department to develop measures to improve and update the teaching methods of the discipline.
Current control	Current knowledge control includes: - control of the solution of situational tasks and exercises completed independently (extracurricular independent work); - assessment of knowing the theoretical material (oral survey and computer testing); - control over the technique of performing the experiment during practical classes and fulfillment of the protocol; - testing in the Moodle system on all topics of the discipline (test tasks include questions of a theoretical and practical nature); - individual assignments (practical and theoretical) for each topic of the discipline being studied.
Interim assessment	The interim assessment is represented by a credit-test, whichstudents pass at the end of 1st semester. The credit-test includes the following stages: - assessment of knowledge of theoretical material (oral survey and interview); - testing in the Moodle system (interim assessment test); - controlof knowing the practicalskillsand abilities; - solving the situational tasks and exercises on each topic of the discipline studied.

2. STRUCTURE AND CONTENT OF THE DISCIPLINE

2.1 Scope of the discipline and types of educational activities

No. p/p	Types of educational work	Total hours	Semester 1
1	Lectures	20	20
2	Practical classes	52	52
3	Independent work of students	36	36
	Total workload intensity in hours	**108**	108
	Total workload in credit units	**3**	3

2.2 Thematic plan of lectures and their content

Item No.	Topics and content of lectures	Codes of formed competencies	Workload intensity (hours)
1	**Elements of probability theory.** Elements of probability theory. Random event. Probability of a random event. Law of addition of probabilities. Normalization conditions. Conditional probability, law of multiplication of probabilities. Bayes formula. Random variables. Distribution of discrete and continuous random variables and their characteristics: mathematical expectation, variance, standard deviation. Laws of distribution of random variables. Normal distribution law.	UC-1 UC-6 GPC-10	2
2	**Mathematical statistics.** Basic concepts of mathematical statistics. General population and sample. Statistical distribution (variation series). Histogram. Polygon. Characteristics of position (mode, median, sample mean) and dispersion (sample variance and sample standard deviation). Estimation of parameters of the general population from its sample (point and interval). Confidence interval and confidence probability. Statistical testing of hypotheses. General formulation of the problem of testing hypotheses. Testing hypotheses about means. Testing hypotheses for variances. Testing hypotheses about distribution laws. Nonparametric criteria.	UC-1 UC-6 GPC-10	2
3	**Correlation and regression analysis.** Correlation and regression analysis. Functional and correlation dependencies. Linear correlation coefficient and its properties. Testing the hypothesis about the significance of the sample linear correlation coefficient. Sample linear regression equation, least squares method. Nonlinear regression.	UC-1 UC-6 GPC-10	2
4	**Medical electronics.** Subject of general and medical electronics. Main groups of electronic medical devices and apparatus. Methods of ensuring safety during operation of electronic medical equipment. Reliability of medical equipment. General scheme of reception, transmission and registration (display) of medical and biological information.	UC-1 UC-6 GPC-10	2
5	**Electrodes and sensors. Pulse current.** Electrodes for bioelectric signal acquisition. Sensors of medical and biological information. Purpose, classification and principles of operation of sensors used in medicine. Analog recording devices. Various continuous information recording systems and their	UC-1 UC-6 GPC-10	2

	characteristics. Amplification of an electrical signal. Electronic amplifiers. Amplifier gain. Amplifier amplitude characteristic. Transmission of medical and biological information over a distance: telemetry and radio telemetry. Structural diagrams of medical devices that record (display) biopotentials (electrocardioscope, electrocardiograph, electroencephalograph, etc.).		
6	**Structure and functions of biological membranes. Artificial membranes.** Concepts of biomembraneology. Structural components of cell membranes. Membrane lipids, their characteristics. Membrane proteins, their characteristics. Physical and physicochemical properties of biological membranes. Surface charge on the cell membrane. Mechanical properties of biological membranes. Mobility of molecular components of biological membranes. Functions and models of biological membranes. Artificial membranes.	UC-1 UC-6 GPC-10	2
7	**Biophysical mechanisms of transport across membranes.** Diffusion in liquid. Fick equation. Diffusion equation for membranes. Permeability coefficient. Ion transport in an electrolyte in the presence of an electric field. Nernst equation and its expression for a membrane. Types of passive transport of molecules and ions through membranes. Active transport. Ussing experiment. Ion pumps and their types. Conjugate processes in ion pumps.	UC-1 UC-6 GPC-10	2
8	**Bioelectrogenesis. Biophysical mechanisms of resting potential and action potential.** Bioelectric potentials. Membrane potentials and their ionic nature. Goldman-Hodgkin-Katz equation. Resting potential. Mechanism of action potential generation. Hodgkin-Huxley equation. Ionic currents during membrane excitation. Propagation of action potential along a nerve fiber.	UC-1 UC-6 GPC-10	2
9	**The role of ion channels in bioelectrogenesis. The mechanism of excitation propagation along nerve fibers.** The role of ion channels in bioelectrogenesis. Scheme of an ion channel. Selective filter and gating mechanism. Understanding of potential-dependent and potential-independent ion channels. The mechanism of excitation propagation along unmyelinated (non-myelinated) and myelinated (myelinated) nerve fibers. The mechanism of formation of extracellular excitation potential.	UC-1 UC-6 GPC-10	2
10	**Biophysical foundations of electrocardiography.** Problems of studying electric fields in the body. Electric dipole. Dipole in an electric field. Electric field of a dipole. Concept of a dipole electric generator (current dipole). Concept	UC-1 UC-6 GPC-10	2

	of an equivalent electric generator of organs and tissues. Physical principles of electrography of tissues and organs. Direct and inverse problem of electrography. Dipole equivalent electric generator of the heart. Genesis of electrocardiograms within the framework of the model of a dipole equivalent electric generator of the heart. Physical principles of vector electrocardiography.		
Total hours			**20**

2.3 Thematic plan of practical classes and their content.

No. p/p	Name of the topics of practical classes	Contents of practical classes	Codes of formed competencies and indicators of their achievements	Types of control	Workload intensity (hours)
1	Differential equations	Entrance control (checking theoretical knowledge and practical skills developed by the physics program in secondary (complete) general education institutions. **Theoretical part:** Differential of a function: definition, notation, formula for finding it. Expression of the derivative of a function through the differentials of a function and argument. Indefinite integral: definition, notation, table of basic integrals. The concept of a differential equation: definition, general notation, order of the equation. General and particular solutions of differential equations. General form of a first-order differential equation with separable variables. **Practical part:** Solution of the main types of first-order differential equations with separable variables. Solution of problems on the breakdown of a drug in the body. To demonstrate the algorithm for solving the problem.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. GPC-10: AI 10.2.	Solving problems and exercises, testing in the Moodle system.	3.25
2	Elements of probability theory	**Theoretical part:** Elements of probability theory. Random event. Probability of a random event. Law of addition of probabilities. Normalization conditions. Conditional probability, law of multiplication of probabilities. Bayes formula. Random variables. Distribution of discrete and continuous random variables and their characteristics: mathematical expectation, variance, standard deviation. Laws of distribution of random variables. Normal distribution law. **Practical part:**	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. GPC-10: AI 10.2. GPC-11: AI 11.3., 11.4.	Frontal interview, solving situational problems and exercises, testing in the Moodle system.	3.25

		Solving problems using classical probability formulas and the theorem of addition and multiplication of probabilities.			
3	Study of statistical methods of processing experimental data	**Theoretical part:** Basic concepts of mathematical statistics. General population and sample. Statistical distribution (variation series). Histogram. Polygon. Characteristics of position (mode, median, sample mean) and dispersion (sample variance and sample standard deviation). Estimation of parameters of the general population from its sample (point and interval). Confidence interval and confidence probability. Statistical testing of hypotheses. General formulation of the problem of testing hypotheses. Testing hypotheses about means. Testing hypotheses for variances. Testing hypotheses about distribution laws. Nonparametric criteria. **Practical part:** Completing a practical task according to a given template.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving situational problems, conducting an experiment, testing in the Moodle system.	3.25
4	Study of relationships between quantities using correlation and regression analysis methods	**Theoretical part:** Correlation and regression analysis. Functional and correlation dependencies. Linear correlation coefficient and its properties. Testing the hypothesis about the significance of the sample linear correlation coefficient. Sample linear regression equation, least squares method. Nonlinear regression. **Practical part:** Completing a practical task according to a given template.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving situational problems, conducting an experiment, testing in the Moodle system.	3.25
5	Test "Higher Mathematics and Statistics	**Theoretical part:** Differential of a function: definition, notation, formula for finding it. Expression of the derivative of a function through the differentials of a function and argument. Indefinite integral: definition, notation, table of basic integrals. Concept of a differential equation: definition, general notation, order of the equation. General and particular solution of differential equations. General form of a first-order differential equation with separable varia-	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, completion of an individual task, testing in the Moodle system.	3.25

		bles. Elements of probability theory. Random event. Probability of a random event. Law of addition of probabilities. Normalization conditions. Conditional probability, law of multiplication of probabilities. Bayes formula. Random variables. Distribution of discrete and continuous random variables and their characteristics: mathematical expectation, variance, standard deviation. Laws of distribution of random variables. Normal distribution law. Basic concepts of mathematical statistics. General population and sample. Statistical distribution (variation series). Histogram. Polygon. Characteristics of position (mode, median, sample mean) and dispersion (sample variance and sample standard deviation). Estimation of parameters of the general population from its sample (point and interval). Confidence interval and confidence probability. Statistical testing of hypotheses. General formulation of the problem of testing hypotheses. Testing hypotheses about means. Testing hypotheses for variances. Testing hypotheses about distribution laws. Nonparametric criteria. Correlation and regression analysis. Functional and correlation dependencies. Linear correlation coefficient and its properties. Testing the hypothesis about the significance of the sample linear correlation coefficient. Sample linear regression equation, least squares method. Nonlinear regression. **Practical part:** Fulfilment of individual cards.			
6	Registration of human ECG with determination of the position of the electrical"axis of the heart."	**Theoretical part:** Mechanism of formation of extracellular excitation potential. What is called a biphasic action potential? Biophysical principles of electrography. What is an electrogram? Its varieties. The principle of recording an electrogram. Electric dipole, its characteristics and properties. The heart as an electric dipole. What is an electrocardiogram? The concept of	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, performing an experiment, testing in the Moodle system.	3.25

		the integral electric vector of the heart (IEHV). Einthoven's triangle. Standard ECG leads. What teeth does the ECG of a healthy person consist of? **Practical part:** Construction of the average electrical axis of the heart in Einthoven's triangle.			
7	Study of hearing acuity by audiometry	**Theoretical part:** What is sound? Characteristics of tones, noises, sound impacts. Objective characteristics of sound: frequency, intensity, acoustic spectrum. The value of the threshold of hearing and the threshold of auditory sensation. Subjective characteristics of sound: pitch, loudness, timbre. What is audiometry, audiogram? Sound research methods: auscultation, percussion, phonocardiography. **Practical part:** Determination of auditory thresholds at different frequencies. Construction of an audiogram.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, experiment execution, testing in the Moodle system.	3.25
8	Biophysical principles of plethysmography	**Theoretical part:** Sensors of medical and biological information, definition, classification. Types of generator sensors and their operating principle. Types of parametric sensors and their operating principle. Biophysical foundations of plethysmography. The concept of photoplethysmography. Physical principles of determining the speed of propagation of a pulse wave. Analysis of factors on which the speed of propagation of a pulse wave depends. Clinical significance of plethysmography. **Practical part:** Registration and analysis of photoplethysmogram. Determination of the average speed of the blood pressure wave (pulse wave propagation speed) passing from the heart to the finger.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving situational problems, conducting an experiment, testing in the Moodle system.	3.25
9	Biophysical bases of electromyography	**Theoretical part:** The concept of electromyography. Biophysical foundations of electrography. The mechanism of electromyogram formation. Devices for medical information recording. Electrodes. Types of electrodes and requirements for them.	UC-1: SD 1.1., 1.2., 1.3. UC-6: SD 6.1., 6.3. UC-8: SD 8.4. GPC-10: SD 10.2. GPC-11: SD 11.1., 11.3.,	Frontal interview, solving situational problems, conducting an ex-	3.25

		Practical part: Registration and analysis of electromyogram.	11.4.	periment, testing in the Moodle system.	
10	Test. Membrane structure. Transport of substances in the body	**Theoretical part:** Concepts of biomembraneology. Structural components of cell membranes. Membrane lipids, their characteristics. Membrane proteins, their characteristics. Physical and physicochemical properties of biological membranes. Surface charge on the cell membrane. Mechanical properties of biological membranes. Mobility of molecular components of biological membranes. Functions and models of biological membranes. Artificial membranes. **Practical part:** Interview.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Interview (assessment of knowledge of theoretical material), testing in the Moodle system.	3.25
11	Physical principles of the action of electromagnetic oscillations and waves on body tissues	**Theoretical part:** Physical processes in tissues when exposed to current and electromagnetic fields. **Practical part:** Introduction to the purpose and main characteristics of the UHF device. Study of thermal effects of the electromagnetic field of the UHF range in a dielectric and conductor.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving exercises, performing an experiment, testing in the Moodle system.	3.25
12	Light absorption. Determination of the concentration of colored solutions using a photoelectrocolorimeter (PEC)	**Theoretical part:** What is light absorption? The formula of Bouguer's law for light absorption, its physical meaning. What is the natural absorption index, what does it depend on The formula of the Bouguer-Lambert-Beer law, its physical meaning. What is the transmittance, optical density? What is concentration colorimetry? What physical quantities are measured directly when using concentration colorimetry methods? **Practical part:** Measuring the optical density of solutions of known concentration (standard solutions with a concentration of 1, 2, 3, 4%) and	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving exercises, performing an experiment, testing in the Moodle system.	3.25

		constructing a calibration graph.Determination of unknown concentrations of solutions.			
13	Study of the operation of a DC bridge	**Theoretical part:** How does the resistance of metals and semiconductors depend on temperature and why? What is a thermistor? Its purpose. What is the calibration of a thermistor? Describe the structure of a DC bridge. What is called a bridge arm? Balanced and unbalanced bridge. Derive a formula for determining resistance using a DC bridge. How to measure an unknown resistance using a bridge circuit? **Practical part:** Determination of body temperature (skin of fingers). Determination of errors in measuring body temperature(skin of fingers).	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, experiment execution, testing in the Moodle system.	3.25
14	Measuring electricalresistance of body tissues and its changes during the cardiac cycle (rheography)	**Theoretical part:** Alternating current (definition, graphical dependence of current or voltage on time). Active, inductive and capacitive resistance in an alternating current circuit. Impedance of an alternating current circuit. Resonance. Resonant frequency. Biophysical principles of the rheography method. **Practical part:** Determination of the active component of resistance of the body area under study. Determination of the maximum change in the active component of resistance. Determination of the heart rate using a rheogram.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Frontal interview, solving situational problems and exercises, performing an experiment, testing in the Moodle system.	3.25
15	Test. Mechanisms of bioelectrogenesis	**Theoretical part:** The role of ion channels in bioelectrogenesis. Scheme of an ion channel. Selective filter and gating mechanism. The concept of potential-dependent and potential-independent ion channels. The mechanism of excitation propagation along unmyelinated (non-myelinated) and myelinated (myelinated) nerve fibers. The mechanism of formation of extracellular excitation potential. **Practical part:** Interview.	UC-1: AI 1.1., 1.2., 1.3. UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	Interview (assessment of knowledge of theoretical material), testing in the Moodle system.	3.25
16	Credit lesson	The interim assessment includes:	UC-1: AI 1.1., 1.2., 1.3.	Interview, prob-	3.25

		- assessment of knowledge of theoretical material; - testing in the Moodle system; - controlof knowingpracticalskillsandabilities; - solving situational problems and exercises.	UC-6: AI 6.1., 6.3. UC-8: AI 8.4. GPC-10: AI 10.2. GPC-11: AI 11.1., 11.3., 11.4.	lem solving and exercises, testing in the Moodle sys-tem.	
Total hours					**52**

2.4 Interactive forms of training

Interactive methods are widely used in practical classes (interactive survey, work in small groups, computer testing, etc.), as well as participation in educational and research and scientific research work.

No. p/p	Topic of the practical class	workload intensity in hours	Interactive form of education	Workload intensity in hours, in % of the practical class
1	Differential equations	3.25	Interactive survey Testing in Moodle	15 min (0.1 hour) / 10% 15 min (0.1 hour) / 10%
2	Elements of probability theory	3.25	Interactive survey Testing in Moodle	15 min (0.1 hour) / 10% 15 min (0.1 hour) / 10%
3	Study of statistical methods of processing experimental data	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) /10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
4	Study of relationships between quantities using correlation and regression analysis methods	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
5	Test "Higher Mathematics and Statistics.	3.25	Interactive survey Testing in Moodle	15 min (0.1 hour) / 10% 15 min (0.1 hour) / 10%
6	Registration of human ECG with determination of the position of the electrical"axis of the heart."	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
7	Study of hearing acuity by audiometry	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 15 min (0.1 hour) / 10%
8	Biophysical principles of plethysmography	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
9	Biophysical bases of electromyography	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
10	Test. Membrane structure. Transport of substances in the body	3.25	Interactive survey and discussion.	3.25 h / 100%
11	Physical principles of the action of electromagnetic oscillations and waves on body tissues	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
12	Light absorption. Determination of the concentration of colored solutions using a photoelectrocolorimeter (PEC)	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%

13	Study of the operation of a DC bridge	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
14	Measuring electri-calresistance of body tissues and its changes during the cardiac cy-cle (rheography)	3.25	Interactive survey Work in groups Testing in Moodle	15 min (0.1 hour) / 10% 40 min (0.25 hour) / 27.4% 15 min (0.1 hour) / 10%
15	Test. Mechanisms of bioelectrogenesis	3.25	Interactive survey and discussion.	3.25 h / 100%
16	Credit	3.25	Testing in Moodle system	90 min (61.5%)

2.5 Criteria for assessment of students' knowledge

The assessment of acquired knowledge is carried out in accordance with the Regulations on the system for assessing the educational results of students of the Federal State Budgetary Educational Institution of Higher Education Amur State Medical Academy of the Ministry of Health of the Russian Federation.

The basis for determining the level of knowledge, skills, and abilities are the assessment criteria - completeness and correctness:

- correct, precise answer;
- correct but incomplete or imprecise answer
- incorrect answer; no answer.

When assigning marks, the classification of errors and their quality are taken into account:

- gross errors;
- similar errors;
- minor errors; shortcomings.

The success of students in mastering the topics of the discipline «Physics, Mathematics» is determined by the quality of mastering knowledge, skills and practical abilities; the assessment is given on a five-point scale: "5" - excellent, "4" - good, "3" - satisfactory, "2" - unsatisfactory.

Evaluation criteria

Quality of development	Mark on a 5-point scale
90 - 100%	"5"
80 - 89%	"4"
70 - 79%	"3"
less than 70%	"2"

Entrance control

Conducted at the first lesson, includes: solving problems and exercises; testing in the Moodle system https://educ-amursma.ru/course/view.php?id=850. Test control includes questions on the physics course studied in secondary (complete) general education institutions.

Current control

Current control includes initial and final control of knowledge.

Initial control **is** carried out by the teacher at the beginning of each class in the form of a frontal interview, solving problems and exercises.

Final control – includes control over the technique of performing the experiment and fulfillment of the protocol, written test by the variants, testing in the Moodle system (https://educ-amursma.ru/course/view.php?id=850).

The final grade during the current knowledge assessment is given on the day of the practical class, as the arithmetic mean result for all types of activities provided for in the given class of the discipline's educational program.

Criteria for assessing the oral answer

- **«5» (excellent)** – the student demonstrates deep and complete knowledge of the educational material, does not allow inaccuracies or distortions of facts when presenting, delivers the material in a logical sequence, is well oriented in the presented material, and can provide justification for the judgments expressed.
- **«4» (good) -** the student has mastered the educational material in full, is well oriented in the educational material, presents the material in a logical sequence, but makes inaccuracies when answering.
- **«3» (satisfactory)** – the student has mastered the basic principles of the topic of the practical lesson, but when presenting the educational material, he/she makes inaccuracies, presents it incompletely and inconsistently, requires leading questions from the teacher to present it, and has difficulty substantiating the judgments expressed.
- **«2» (unsatisfactory)** – the student has fragmented and unsystematic knowledge of the educational material, is unable to distinguish between the main and the secondary, makes mistakes in defining basic concepts, distorts their meaning, and cannot independently present the material.

Assessment criteria for the practical part

- **«5» (excellent)** – the student has fully mastered the practical skills and abilities provided for by the course educational program.
- **«4» (good)** – the student has fully mastered the practical skills and abilities provided for the course program, but makes some inaccuracies.
- **«3» (satisfactory)** – the student has only some practical skills and abilities.
- **«2» (unsatisfactory)** – the student demonstrates the performance of practical skills and abilities with gross errors.

Criteria for assessing independent extracurricular work:

- the level of mastering the educational material by a student;
- the completeness and depth of general educational concepts, knowledge and skills on the topic being studied, to which this independent work relates;
- development of universal and general professional competencies (ability to apply theoretical knowledge in practice).
- the problems were solved correctly, the exercises were completed, and the test assignments were answered accurately – "passed".
- Problems were not solved correctly, exercises were not completed correctly, test assignments were not answered accurately – "failed".

Evaluation criteria of written report:

- **«5» (excellent) –** awarded to a student if he has prepared a complete, detailed, and formatted according to requirements, abstract on the chosen topic, presented his work in the form of a report with a computer presentation, and answered questions on the topic of the report;
- **«4» (good) –** awarded to a student for a complete, detailed report that is formatted according to requirements, but poorly presented;
- **«3» (satisfactory) –** the report does not contain information on the issue being studied in full, is formatted with errors, and is poorly presented;

- **«2» (unsatisfactory)** – given to a student if the report is not written, or is written with gross errors, the report and computer presentation are not prepared, or their content does not correspond to the topic of the report.

Retake the disciplinary debts.

1. If a student misses a class for a valid reason, he/she has the right to retake it and receive the maximum grade provided for that class by the course educational program.A valid reason must be documental approved.
2. If a student misses a class for an unjustified reason or receives a «2» mark for all activities in the class, he/she is required to retake it. In this case, the mark received for all activities is multiplied by 0.8.
3. If a student is excused from a class at the request of the dean's office (participation in sports, cultural and other events), then he is given a grade of «5» for this class, provided that he submits a report on the completion of mandatory extracurricular independent work on the topic of the missed class.

Criteria for interim assessment.

Interim assessment (credit-test) is designed to assess the degree of achievement of planned training results upon completion of the study of a discipline and allows for an assessment of the level and quality of its mastery by students.

The students' success in mastering the discipline is assessed on a 5-point scale: «5» – excellent, «4» – good, «3» – satisfactory, «2» – unsatisfactory.

«Excellent» - for the depth and completeness of mastering the content of the educational material, in which the student easily use, for the ability to connect theoretical questions with practical ones, express and justify their judgments, correctly and logically present the answer; when testing, allows up to 10% of erroneous answers. Practical skills and abilities provided for by the educational program of the discipline are fully mastered.

«Good» - the student has fully mastered the educational material, is oriented in it, correctly states the answer, but the content and form have some inaccuracies; during testing allows up to 20% of erroneous answers. Completely possess practical skills and abilities provided by the educational program of the discipline, but have some inaccuracies while answering.

«Satisfactory»- the student has mastered the knowledge and understanding of the main provisions of the educational material, but presents it incompletely, inconsistently, does not know how to express and justify his/her judgments; during testing, allows up to 30% of erroneous answers. He/she has only some practical skills and abilities.

«Unsatisfactory»- the student has fragmented and unsystematic knowledge of the educational material, is unable to distinguish between the main and secondary, makes mistakes in defining concepts, distorts their meaning, presents the material in a disorderly and uncertain manner, and makes more than 30% of erroneous answers during testing. He performs practical skills and abilities with gross errors.

A student can claim to receive an "excellent" grade automatically if he/she has won a prize in disciplinary or interdisciplinary Olympiads (university, regional) and has an average grade for the current academic performance of at least 4.8 points **.**A student can refuse the "automatic" grade and take the test together with the group on a general basis.

Interim assessment is carried out through a system of passing a credit-test in 3 stages:

1. Testing in the Moodle system (https://educ-amursma.ru/course/view.php?id=850).
2. Completion of the practical part of the discipline in full: involves attending all practical classes, performing experiments with the execution of a protocol. Based on the assessments of the current control of knowledge, skills, and abilities in practical classes, the average score of current academic performance is calculated, which is recorded in the educational (electronic) journal. The average score of the current knowledge control is taken into account during the midterm assessment.
3. Delivery of practical skills (control of the level of development of competencies). Includes 10 variants, containing 10 practical questions each.

Evaluation criteria for interim assessment

Stages	Mark out of 5point scale	Binary scale
Test control in the Moodle system	3-5	**passed**
Complete completion of the practical part of the course	3-5	
Testing of practical skills (control of the formation of competencies)	3-5	
Test control in the Moodle system	2	**not credited**
Full completion of the practical part of the course	2	
Testing of practical skills (control of the formation of competencies)	2	

2.6 Independent work of students: classroom and extracurricular work.

The organization of independent classroom work of students is carried out with the help of methodological instructions for students, which contain educational goals, a list of the main theoretical questions for study, a list of practical work and the methodology for conducting it, instructions for the presentation of the results obtained, their discussion and conclusions, assignments for self-control with standard answers, a list of recommended literature.

From 1/4 to 1/2 of the practical lesson time is allocated for independent work of students: conducting research, recording results, discussing them, formulating conclusions, making individual assignments. The preparatory stage, or the formation of an approximate basis for actions, begins for students outside of class time when preparing for the practical lesson, and ends in class.

All subsequent stages are carried out in class. The stage of materialized actions (solving problems using an algorithm or without an algorithm, with an unknown answer in advance) is carried out independently. The teacher, if necessary, provides consultation, provides assistance and simultaneously monitors the quality of students' knowledge and their ability to apply existing knowledge to solve assigned problems.

No. p/p	Topic of practical class	Time for student to prepare for the class	Forms of extracurricular independent work	
			Mandatory and uniform for all students	A student's choice (report on a topic)
1	Differential equations	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems completing a practical task (problem) to monitor the assimilation of the topic.	- thesis "The law of drug decomposition in the body"; - thesis "Determination of the rate of bacterial reproduction"; - report "The law of drug decay in the body".
2	Elements of	2 hours	- preparation for practical	- thesis "How to check

	probability theory		classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	the distribution of medical indicators for normality."
3	Study of statistical methods of processing experimental data	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	- thesis"Algorithm for selecting statistical research methods"; - thesis"Criteria for the application of nonparametric research methods.
4	Study of relationships between quantities using correlation and regression analysis methods	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic."	- report on the topic "Correlation analysis in medicine"; - thesis "Application of correlation analysis in medicine".
5	Test "Higher Mathematics and Statistics.	2 hours	- preparation for tests (lectures, basic and additional literature); - repeat examples of solutions to typical problems; - Completion of a sample test.	completing a sample test
6	Registration of human ECG with determination of the position of the electrical"axis of the heart."	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task	- report on the topic " Determining the position of the electrical axis of the heart."

			(problem) to monitor the assimilation of the topic.	
7	Study of hearing acuity by audiometry	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	- report on the topics "Biophysical mechanisms of auditory perception " and "Features of air and bone conduction of mechanical vibrations".
8	Biophysical principles of plethysmography	1 hour	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	- report on the topics "Types of plethysmography and" and "Diagnostic value of plethysmography".
9	Biophysical bases of electromyography	1 hour	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	- report on the topic "Modern options for using EMG in medicine"
10	Test. Membrane structure. Transport of substances in the body	2 hours	- preparation for tests (lectures, basic and additional literature); - making a plan to answer questions.	- Report on the topic "Modern concepts of the structure of biological membranes".
11	Physical principles of the action of electromagnetic oscillations and waves on body tissues	1 hour	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic."	- Report "UHF application in medicine"; - abstract "Application of pulsed currents in medicine".
12	Light absorption. Determination of the concentration of colored solutions using a pho-	1 hour	- preparation for practical classes (lectures, basic and additional literature); - makinga plan to answer	- thesis on the topic "Options for using FEC in medicine".

	toelectrocolor-imeter (PEC)		questions; - completing a practical task (problem) to monitor the assimilation of the topic.	
13	Study of the operation of a DC bridge	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	- report on the topic "Application of a DC bridge in medical devices ".
14	Measuring electricalresistance of body tissues and its changes during the cardiac cycle (rheography)	2 hours	- preparation for practical classes (lectures, basic and additional literature); - making a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	- Report on the topics "The role of rheography in diagnostics" and "The use of rheography in medicine".
15	Control Test. Mechanisms of bioelectrogenesis	2 hours	- preparation for tests (lectures, basic and additional literature); - making a plan to answer questions.	- Report on the topic "The mechanism of excitation propagation along nerve fibers" "The role of various ions in the occurrence of excitation".
16	Interim assessment	2 hours	- preparation for the test (lectures, basic and additional literature); - making a plan to answer questions; - preparing for a test assignment.	
workload intensity in hours		30 hours	30 hours	6 hours
Total workload intensity in hours			**36 hours**	

2.7 Research (project) work

Research (project) work of a student isa mandatory section of the discipline and is aimed at the comprehensive formation of universal and general professional competencies of students. Research (project) work involves the study of specialized literature and other scientific and technical information on the achievements of domestic and foreign science and technology in the relevant field of knowledge, participation in scientific research, etc. The topics are determined by students independently or in consultation with the teacher.

List of recommended topics for research (project) work:

1. Features of the application of mathematical statistics in biology and medicine.
2. Study of the influence of noise on living organisms.
3. Study of approximate methods for calculating definite integrals using computer simulation.
4. Computer modeling and research of the resonance curve in the circuit.
5. Noise pollution of the environment.
6. On-board computer and manufacturing of temperature sensor.
7. Application of correlation analysis in medicine.
8. Modern concepts of the structure of biological membranes.
9. Features of air and bone conduction of mechanical vibrations.
10. Modern concepts of the structure of biological membranes.
11. Diagnostic value of plethysmography.
12. Modern applications of EMG in medicine.
13. Electrical models of the cardiovascular system.
14. Mechanical models of the cardiovascular system.
15. Artificial blood circulation apparatus.

Criteria for assessment of students' research (project) work:

- the material on the results of the research in the report is presented in detail, the specialized literature is well-developed, scientific and technical information on the achievements of domestic and foreign science and technology in the relevant field of knowledge is studied - "passed".
- the material on the results of the research in the report is not presented accurately enough, the special literature is poorly studied, the scientific and technical information on the achievements of domestic and foreign science and technology in the relevant field of knowledge is not studied - "failed".

3. EDUCATIONAL, METHODOLOGICAL, MATERIAL, TECHNICAL AND INFORMATION SUPPORT OF THE DISCIPLINE

3.1 Main literature:

1. Remizov, A. N. Medical and biological physics: textbook / A. N. Remizov. - 4th ed., corrected and revised. - Moscow: GEOTAR-Media, 2023. - 656 p. - ISBN 978-5-9704-7498-3. - Text: electronic // Electronic Library System "Student Consultant". Access mode: https://www.studentlibrary.ru/book/ISBN9785970474983.html
2. Pavlushkov, I. V. Mathematics: textbook / I. V. Pavlushkov, L. V. Rozovsky, I. A. Narkevich. - Moscow: GEOTAR-Media, 2022. - 320 p. - ISBN 978-5-9704-7082-4. - Text: electronic // Electronic Library System "Student Consultant". Access mode: https://www.studentlibrary.ru/book/ISBN9785970470824.html

3.2 Additional literature:

1. Medical and biological physics: a textbook / V. N. Khilmanovich, I. M. Bertel, S. I. Klintsevich [et al.]. - Grodno: Grodno State Medical University, 2023. - 320 p. - ISBN 978-985-595-750-9. - Text: electronic // Lan: electronic library system. - Access mode: https://e.lanbook.com/book/340739
2. Plashchevaya, E. V. Tests for laboratory work in physics: a teaching aid / E. V. Plashchevaya, N. V. Nigey. - Blagoveshchensk: Amur State Medical Academy of the Ministry of Health of the Russian Federation, 2024. - 140 p. - Text: electronic // Lan: electronic library system .Access mode :https://e.lanbook.com/book/447482

3.3 Educational and methodological support for the discipline prepared by the department staff:

Educational aids (Educational Methodology):

1. Plashchevaya E.V., Nigey N.V., Smirnov V.A., Lysak V.A. Laboratory practical training in the discipline "Physics, Mathematics" section "Physics" (practical training). Recommended by the UMO RAE for classical university and technical education. Blagoveshchensk: Printing house OOO "Bukvitsa", 2021, 219 p.
2. Plashchevaya E.V., Nigey N.V., Smirnov V.A., Lysak V.A. Textbook on the subject "Physics, Mathematics" section "Physics"(study guide). Blagoveshchensk: Printing house OOO Bukvitsa, 2021, 221 p.

Electronic and digital technologies:

1. Online course on the subject "Physics, Mathematics" in the EIS FGBOU VO Amur State Medical Academy (https://educ-amursma.ru/course/view.php?id=850).

Characteristics of modules in electronic information and educationalcourse

Educational	Controlling
Theoretical (lecture) material, video experiments, scientific and educational films	Methodological recommendations for students on independent extracurricular work.
Methodological recommendations for students for practical classes. Methodological recommendations for solving problems and exercises on the topics of the discipline.	List of recommended topics for abstracts and guidelines for abstract design.
Reference material, tables of standard values.	Tests of entrance, current and final knowledge control.

2. Multimedia presentations for lecture-type classes (https://educ-amursma.ru/course/view.php?id=850)according to the lecture thematic plan:
   - Elements of probability theory.
   - Biological membranes.
   - Transport of substances in the body.
   - Biophysics of hearing.
   - Biophysics of vision.
   - Biophysics of muscle contraction.
   - Biomechanics of blood circulation.
3. Video materials:
   - Biophysics.
   - Introduction to Biomembranology.

- Structure and functions of membranes.
- Biological membranes
- Medical and biological statisticsExpress course.

4. Electronic teaching aids:
(placed in the Electronic Information System of the Federal State Budgetary Educational Institution of Higher Education Amur State Medical Academy. Access mode:
(https://educ-amursma.ru/course/view.php?id=850).
   - electronic teaching aid on the subject "Physics, Mathematics". Section "Mathematics ";
   - Electronic teaching aid "Laboratory practical training in the discipline "Physics, Mathematics". Section "Physics ".

3.4 Equipment used for the educational process

No. p/p	Name	Quantity
1.	**Practical training room: Lab 1 (Practical 2)**	
	Polygraph MP-36 (BIOPAC)	1
	Set of sensors	1
	DC bridge	1
	Board	1
	Teacher's desk	1
	Study table	11
	Chairs	20
	Handout kits	30
2.	**Practical training room: Laboratory 2 (DK - 3)**	
	Electrocardiograph "Axion"	1
	Rheograph P4 - 02	2
	Computer	13
	Teacher's desk	1
	Board	1
	Study table	7
	Chairs	20
	Handout kit	30
3.	**Practical training room: Lab 3 (Practical 3)**	1
	Physiotherapeutic device UHF-50-01	1
	Automated audiometer AA-02	2
	Board	1
	Teacher's desk	1
	Study table	7
	Chairs	20
	Handout kit	30
4	**Practical training room: Laboratory 4 (DK - 2)**	2
	Photoelectrocolorimeter (PEC)	1
	Electrocardiograph "Axion"	1
	Computer	17
	Board	1
	Teacher's desk	1
	Study table	11
	Chairs	20

	Handout kit	30
5	**Room for independent work of students (DK - 1)**	
	Computer	18
	Board	1
	Teacher's desk	1
	Study table	13
	Chairs	20
	Handout kit	30

3.5. Professional databases, information and reference systems, electronic educational resources.

Name resource	Resource Description	Access	Resource address
ELECTRONIC LIBRARY SYSTEMS			
"Student consultant. Electronic library of the medical university"	For students and teachers of medical and pharmaceutical universities. Provides access to electronic versions of textbooks, teaching aids and periodicals.	Remote access after registration under the university profile	https://www.studentlibrary.ru/
Reference and information system "MedBaseGeotar".	The reference and information system "MedBaseGeotar" is intended for practicing medical specialists, researchers, teachers, postgraduate students, residents, senior students, and healthcare managers for the rapid search, selection, and reading of medical literature necessary for work in a single data source.	Remote access after registration under the university profile	https://mbasegeotar.ru/pages/index.html
Electronic library system "Bookup"	Large medical library - information and educational platform for the joint use of electronic educational, educational and methodological publications of medical universities of Russia and the CIS countries	Remote access after registration under the university profile	https://www.books-up.ru/
EBS "Lan"	Network electronic library of medical universities - an electronic database of educational and scientific works on medical topics, created for the purpose of implementing network forms of professional educational programs, open access to educational materials for partner universities	Remote access after registration under the university profile	https://e.lanbook.com/
Scientific electronic library "CyberLeninka"	CyberLeninka is a scientific electronic library built on the paradigm of open science (Open Science), the main tasks of which are the popularization of science and scientific activity, public con-	free access	https://cyberleninka.ru/

	trol of the quality of scientific publications, the development of interdisciplinary research, a modern institute of scientific review, increasing the citation of Russian science and building a knowledge infrastructure. Contains more than 2.3 million scientific articles.		
Oxford Medicine Online	A collection of Oxford Press medical publications, bringing together over 350 titles into a single, cross-searchable resource. Publications include The Oxford Handbook of Clinical Medicine and The Oxford Textbook of Medicine, both of which are continually updated electronically.	free access	http://www.oxfordmedicine.com
Human Biology Knowledge Base	Reference information on physiology , cell biology , genetics , biochemistry , immunology , pathology . (Resource of the Institute of Molecular Genetics of the Russian Academy of Sciences .)	free access	http://humbio.ru/
Medical online library	Free reference books, encyclopedias, books, monographs, abstracts, English-language literature, tests.	free access	https://www.medlib.ru/library/library/books
INFORMATION SYSTEMS			
Clinical Guidelines Rubricator	A resource of the Russian Ministry of Health that contains clinical recommendations developed and approved by medical professional non-profit organizations of the Russian Federation, as well as methodological guidelines, nomenclatures and other reference materials.	Link to download the application	https://cr.minzdrav.gov.ru/#!/
Federal Electronic Medical Library (FEMB)	The Federal Electronic Medical Library is part of the unified state information system in the field of healthcare as a reference system. FEMB was created on the basis of the funds of the Central Scientific Medical Library named after I.M. Sechenov.	free access	https://femb.ru/
Russian Medical Association	Professional Internet resource. Objective: to promote effective professional activity of medical personnel. Contains the charter, personnel, structure, rules of entry, information about the Russian Medical Union.	free access	http://www.rmass.ru/
Web-medicine	The site presents a catalog of professional medical resources, including links to the most authoritative subject sites, journals, societies, as well as useful documents and programs. The site is	free access	http: //webmed.irkutsk.ru/

	intended for doctors, students, employees of medical universities and scientific institutions.		
DATABASES			
World Health Organization	The site contains news, statistics on countries that are members of the World Health Organization, fact sheets, reports, WHO publications and much more.	free access	http://www.who.int/ru/
Ministry of Science and Higher Education of the Russian Federation	The website of the Ministry of Science and Higher Education of the Russian Federation contains news, newsletters, reports, publications and much more.	free access	http://www.minobrnauki.gov.ru
Ministry of Education of the Russian Federation	The website of the Ministry of Education of the Russian Federation contains news, newsletters, reports, publications and much more.	free access	https://edu.gov.ru/
Federal portal "Russian education"	A single window for access to educational resources. This portal provides access to textbooks on all areas of medicine and health care.	free access	http: //www .edu.ru/
Polpred.com	Electronic library system Business media. Media review	free access	https://polpred.com/news
BIBLIOGRAPHICAL DATABASES			
Database "Russian Medicine"	It is created in the Central Scientific and Methodological Library and covers the entire collection, starting from 1988. The database contains bibliographic descriptions of articles from domestic journals and collections, dissertations and their abstracts, as well as domestic and foreign books, collections of institute proceedings, conference materials, etc. Thematically, the database covers all areas of medicine and related areas of biology, biophysics, biochemistry, psychology, etc.	free access	https://rucml.ru/
PubMed	A text database of medical and biological publications in English. The PubMed database is an electronic search engine with free access to 30 million publications from 4,800 indexed journals on medical topics. The database contains articles published from 1960 to the present day, including information from MEDLINE, PreMEDLINE, NLM. Each year, the portal is replenished with more than 500 thou-	free access	https :// pubmed . ncbi . nlm . nih . gov /

	sand new works.		
eLIBRARY.RU	Russian information portal in the field of science, technology, medicine and education, containing abstracts and full texts of more than 13 million scientific articles and publications. The eLIBRARY.RU platform provides electronic versions of more than 2,000 Russian scientific and technical journals, including more than 1,000 open access journals.	Full functionality of the site is available after registration	http://elibrary.ru/defaultx.asp
Electronic library of dissertations (RSL)	Currently, the Electronic Library of Dissertations of the Russian State Library contains more than 919,000 full texts of dissertations and abstracts.	free access	http://diss.rsl.ru/?menu=disscatalog/
Medline.ru	Medical and biological portal for specialists. Biomedical journal.	free access	https://journal.scbmt.ru/jour/index
Official Internet portal of legal information	The single official state information and legal resource in Russia	free access	http://pravo.gov.ru/

3.6. Licensed and freely distributed software used in the educational process.

List of software (commercial software products).

No. p/p	List of software (commercial software products)	Details of confirming documents documents
1.	MS Operating System Windows 7 Pro	License number 48381779
2.	MS Operating System Windows 10 Pro	CONTRACT No.UT-368 from 09.21.2021
3 .	MS Office	License number: 43234783, 67810502, 67580703, 64399692, 62795141, 61350919
4.	Kaspersky Endpoint Security for Business – Standard Russian Edition. 50-99 Node 1-year Educational Renewal License	Agreement No. 7 AA dated 02/07/2025
5.	1C Accounting and 1C Salary	LICENSE AGREEMENT 612/L dated 02.02.2022 (additional licenses)
6.	1C: PROF University	LICENSE AGREEMENT No. KrTsB-004537 dated 12/19/2023
7.	1C: PROF Library	LICENSE AGREEMENT No. 2281 dated 11.11.2020
8.	Consultant Plus	Contract No. 41AA dated 12/27/2024
9.	Contour.Tolk	Agreement No. K213753/24 dated 13.08.2024
10.	E-learning environment 3KL (Russian Moodle)	Agreement No. 1362.5 dated November 20, 2024
11.	Astra Linux Common Edition	Agreement No. 142 A dated September 21, 2021
12.	Information system "Plans"	Agreement No. 2873-24 dated June 28,

		2024
13.	1C: Document Management	Agreement No. 2191 dated 10/15/2020
14.	R7-Office	Agreement No. 2 KS dated 12/18/2020
15.	License "OS ROSA CHROME workstation"	Agreement No. 88A dated 08/22/2024
16.	Alt Virtualization Server 10 (for secondary specialized and higher professional education)	Agreement No. 14AK dated 09/27/2024
17.	Dr.Web Desktop Security Suite Comprehensive protection + Control Center for 12 months.	Agreement No. 8 dated October 21, 2024
18.	Software "Schedule for educational institutions"	Agreement No. 82A dated July 30, 2024

List of freely distributed software

No. p/p	**The list is free distributed software**	**Links to license agreement**
1.	Yandex Browser	Freely distributed License Agreement for the Use of Yandex Browser Programs https://yandex.ru/legal/browser_agreement/
2.	Yandex.Telemost	Freely distributed License agreement for the use of programs https://yandex.ru/legal/telemost_mobile_agreement/
3.	Dr.Web CureIt!	Freely distributed License Agreement: https://st.drweb.com/static/new-www/files/license_CureIt_ru.pdf
4.	OpenOffice	Freely distributed License: http://www.gnu.org/copyleft/lesser.html
5.	LibreOffice	Freely distributed License:https://ru.libreoffice.org/about-us/license/
6.	VK Calls	Freely distributed https://vk.com/license
7.	Kaspersky Free Antivirus	Freely distributed https://products.s.kaspersky-labs.com/homeuser/Kaspersky4Win2021/21.16.6.467/english-0.207.0/3830343439337c44454c7c4e554c4c/kis_eula_en-in.txt

3.7. Resources of the information and telecommunications network "Internet"

- Library of Amur State Medical Academy. Access mode: https://amurgma.ru/obuchenie/biblioteki/biblioteka-amurskoy-gma/
- Electronic library system "Student consultant". Access mode: https://www.studentlibrary.ru

4. ASSESSMENT TOOLS FUND

4.1. Current test control (entrance, initial, output), final.

4.1.1 Examples of entrance control test tasks (with standard answers)

Test assignments are located in the Moodle system. Access mode: https://educ-amursma.ru/course/view.php?id=850 . Total number of test's questions – 100.

1. WHAT IS THE MAIN TASK OF MECHANICS?
    1) in determining the position of the body at any given moment in time
    2) in the study of different body movements
    3) e in determining the causes of body movement
    4) in determining the path traveled by the body
2. WHAT PHENOMENON OCCURRES DUE TO THE ACTION OF FRICTION?
    1) the car starts moving
    2) the stone falls to the ground
    3) the pendulum oscillates
    4) the load is hanging on a rope
3. THE DEVICE FOR MEASURING CURRENT STRENGTH IS CALLED:
    1) ammeter
    2) voltmeter
    3) hygrometer
    4) tonometer

Answer standards: 1-1; 2-1; 3-1.

4.1.2 Examples of test tasks for initial control (with standard answers)

Test assignments are located in the Moodle system. Access mode: https://educ-amursma.ru/course/view.php?id=850 . Total number of tests – 200.

1. WHAT IS THE NAME OF THE PHYSICAL QUANTITY THAT QUANTITATIVELY CHARACTERIZES THE FLOW OF ENERGY TRANSPORTED BY LIGHT?
    1) light intensity
    2) optical density
    3) transmittance coefficient
    4) absorption coefficient
2. WHEN ANALYZING EMG THE FOLLOWING IS TAKEN INTO ACCOUNT:
    1) biopotential frequency
    2) the magnitude of their amplitude (voltage)
    3) the general structure of the oscillograms - the monotony of the oscillations or their division into volleys, the frequency and duration of these volleys, etc.

4) age of the subject being tested

3. HYPERPOLARIZATION IS:
   1) the process of formation of a double electrical layer on both sides of the membrane
   2) increase in resting potential by modulus
   3) decrease in resting potential by modulus
   4) returning a section of the membrane to its original state

Answer standards: 1-1; 2-3; 3-2.

4.1.3 Examples of test tasks for final control (with standard answers)

Test assignments are located in the Moodle system. Access mode: https://educ-amursma.ru/course/view.php?id=850 . Total number of tests – 200.

1. WHAT IS THE NAME OF THE CURVE THAT SHOWS THE CHANGE IN TIME OF THE POTENTIAL DIFFERENCE ON THE SURFACE OF THE CARDIAC MUSCLE THAT OCCUR AS A RESULT OF ITS EXCITATION?
   5) electromyogram
   6) electrogastrogram
   7) electrocardiogram
   8) electroretinogram
2. A TYPE OF DIFFUSION IN WHICH THE MOLECULES OF THE DIFFUSING SUBSTANCE MOVES IN THE MEMBRANE WITHOUT FORMING COMPLEXES WITH OTHER MOLECULES:
   5) simple
   6) lightweight
   7) exchange
   8) variable
3. THE ENERGY CHARACTERISTIC OF SOUND IS:
   5) frequency
   6) acoustic spectrum
   7) volume
   8) intensity

Answer standards: 1-3; 2-1; 3-4.

4.1.4 Examples of test tasks for assessing practical skills (with standard answers)

Test assignments are located in the Moodle system. Access mode: https://educ-amursma.ru/course/view.php?id=850 . Total number of tests – 200.

1. FORMULA OF PRP SHOULDIN THE VESSELS OF THE ARMS AND LEGS (MUSCLE TYPE):
   1) With $_{P}$ = 8V +425
   2) With $_{E}$ = B ^{2} + 4B + 380
   3) With $_{E}$ = B2 $^{+}$ 4B + 425
   4) With $_{P}$ = 8V +380
2. THE DURATION OF THE POTENTIAL OF ACTION FOR NERVE TISSUES IS:
   1) 0.1-0.5 ms
   2) 1-5 ms
   3) 10-50 ms

4) 50-100 ms

3. NAME OF THE QUANTITY " r " INCLUDED IN THE FORMULA$t = k \cdot c \cdot r$
    1) resistance of all areas through which an electrical impulse passes
    2) membrane resistance
    3) resistance of all sections through which the circular current flows
    4) membrane capacity

Answer standards: 1-1; 2-2; 3-3.

4.1.5 Examples of test tasks for the final assessment (with standard answers)

Test assignments are located in the Moodle system. Access mode: https://educ-amursma.ru/course/view.php?id=850 . Total number of tests – 200.

1. THE METHOD OF THERAPEUTIC IMPACT WITH HIGH-FREQUENCY ALTERNATING PULSED CURRENT OF HIGH VOLTAGE UP TO 20 kV AND LOW STRENGTH OF 0.02 MA IS CALLED:
    1) darsonvalization
    2) electrosurgery
    3) microwave therapy
    4) inductothermy
2. A DEVICE USED IN MEDICINE AND BIOLOGY TO DETERMINE TEMPERATURE, WHICH IS BASED ON A SMALL-SIZED CRYSTALLINE SEMICONDUCTOR:
    1) thermometer
    2) thermistor
    3) rheostat
    4) galvanometer
3. WHEN APPLYING ELECTRODES FOR REGISTRATION OF ECG TO THE LEFT ARM, THE ELECTRODE IS INSTALLED:
    1) red
    2) yellow
    3) green
    4) black

Answer standards: 1-1 ; 2-2; 3-2.

4.2 Situational tasks, exercises

Example No. 1.

To study the relation between systolic pressure Y of men in the initial stage *of* shock and their age X. The results of observations are presented in the table:

X	68	37	50	53	75	66	52	65	74	65	54
Y	114	149	146	141	114	112	124	105	141	120	124

Calculate the sample correlation coefficient and estimate the strength and direction of the relationship between the studied values. Write a linear regression equation.
Confidence level P=0.95.

Solution:

Let's make a calculation table:

No.	X_i	Y_i	$X_i \cdot Y_i$	X_i^2	Y_i^2
1	68	114	7752	4624	12996
2	37	149	5513	1369	22201
3	50	146	7300	2500	21316
4	53	141	7473	2809	19881
5	75	114	8550	5625	12996
6	66	112	7392	4356	12544
7	52	124	6448	2704	15376
8	65	105	6825	4225	11025
9	74	141	10434	5476	19881
10	65	120	7800	4225	14400
11	54	124	6696	2916	15376
∑	659	1390	82183	40829	177992

1. Calculate the product $X_i \cdot Y_i$.
2. Calculate X_i^2.
3. Calculate Y_i^2.
4. Find the sums of the values, i.e. fill in the last line of the calculation table.
5. Calculate the correlation coefficient:

$$r = \frac{n \cdot \sum X_i \cdot Y_i - \sum X_i \cdot \sum Y_i}{\sqrt{(n \cdot \sum X_i^2 - (\sum X_i)^2) \cdot (n \cdot \sum Y_i^2 - (\sum Y_i)^2)}} =$$

$$= \frac{11 \cdot 82183 - 659 \cdot 1390}{\sqrt{(11 \cdot 40829 - 659^2) \cdot (11 \cdot 177992 - 1390^2)}} = \frac{-11997}{19570{,}346} = -0{,}613$$

6. Using the formula $t = \left| r \cdot \sqrt{\frac{n-2}{1-r^2}} \right|$, calculate the reliability criterion of the correlation coefficient:

$$t = 0{,}613 \frac{\sqrt{11-2}}{\sqrt{1-0{,}613^2}} = 2{,}33.$$

Student's t-test for k = n-2 = 11-2 = 9 and P=0.95 t_{st} = 2.26.

7. We draw a conclusion: Since $t > t_{st}$, then with a probability of P=0.95 it can be stated that there is an average and inverse correlation between the systolic pressure of men in the initial stage of shock and age .

8. The linear regression equation has the following form:

$$Y = a + b \cdot X,$$

where X is the value of the independent variable,
Y is the value of the dependent variable,
a ,*b* – parameters of the equation (*a* – shift coefficient,
b is the slope coefficient or regression coefficient).

а) Calculate the arithmetic mean:

$$\overline{X} = \frac{\sum X_i}{n} = \frac{659}{11} = 59{,}91 \quad \overline{Y} = \frac{\sum Y_i}{n} = \frac{1390}{11} = 126{,}36$$

б) Calculate the value of the regression coefficient using the formula:

$$b = \frac{n \cdot \sum X_i \cdot Y_i - \sum X_i \cdot \sum Y_i}{n \cdot \sum X_i^2 - (\sum X_i)^2}$$

The amounts for calculation are taken from the table, bottom line.

Regression coefficient:

$$b = \frac{n \cdot \sum X_i \cdot Y_i - \sum X_i \cdot \sum Y_i}{n \cdot \sum X_i^{\,2} - (\sum X_i)^2} = \frac{11 \cdot 82183 - 659 \cdot 1390}{11 \cdot 40829 - 659^2} = \frac{-11997}{14838} = -0{,}81.$$

c) Calculate the shift coefficient:

$$a = \overline{Y} - b \cdot \overline{X} = 126{,}36 + 0{,}81 \cdot 59{,}91 = 174{,}89\ ,$$

Regression equation: Y = 174.98 - 0.81 X.

Conclusion:

When the age of men changes by 1-year, systolic pressure in the initial stage of shock changes on average by an amount equal to the regression coefficient *b* = -0.81 units.

Example No. 2.

The arithmetic means and errors of the arithmetic means of two samples are given. Using the reliability criterion, find out whether the difference in the arithmetic means of these samples will be reliable. The confidence level is assumed to be 0.95.

$$\overline{X}_1 = 163 \qquad m_1 = 6 \qquad n_1 = 9$$
$$\overline{X}_2 = 179 \qquad m_2 = 5 \qquad n_2 = 7$$

Solution:

The reliability criterion for the difference in the arithmetic means of two samples is calculated using the formula:

$$t = \frac{\left|\overline{X}_1 - \overline{X}_2\right|}{\sqrt{m_1^2 + m_2^2}} = \frac{|163 - 179|}{\sqrt{5^2 + 6^2}} \approx 1{,}90$$

According to the table for k = n_1 + n_2 –2 = 7 + 9 –2 = 14 and P = 0.95 we find the Student's coefficient t_{st} = 2.14.

t is compared with the table value and we conclude: since $t < t_{st}$, then the difference between the arithmetic means of the samples under consideration is not reliable.

Example No. 3.

A student came to an exam knowing 50 questions out of 60. The examiner asked the student four questions. What is the probability that the student knows the answer to the first and second questions and does not know the answer to the third and fourth questions?

Given:	Solution:
n = 60 m_1 = 50 *m2* = $_{10}$ *P(A and B andC and D)* = ?	Event *A* – the student knows the answer to the 1st question, event *B* – the student knows the answer to the 2nd question, event *C* – the student does not know the answer to the 3rd question, Event *D* – the student does not know the answer to the 4th question.

Events *A* and*B*and *C* and *D* are dependent, therefore, to find the desired probability, we apply the multiplication theorem for dependent events:

$P(A \text{ and } B \text{ and } C \text{ and } D) = P(A) \cdot P_A(B) \cdot P_B(C) \cdot P_C(D)$. Let us find the probability of occurrence of event *A* and the conditional probabilities of occurrence of events *B* ,*C* , *D*.

the probability of occurrence of event *A* using the formula:

$$P(A) = \frac{m_1}{n},$$

where m_1 is the number of questions that the student knows,

n – total number of questions.

$$P(A) = \frac{m_1}{n} = \frac{50}{60} = \frac{5}{6}.$$

Since one question that the student knows is taken away, the total number of questions will be one less, and the number of questions that the student knows will be one less, so the conditional probability of the occurrence of event B is:

$$P_A(B) = \frac{m_1 - 1}{n - 1} = \frac{49}{59}.$$

Two questions were taken away, so the total number of questions is $n - 2$, the number of questions that the student does not know is m_2. The conditional probability of the occurrence of event C is:

$$P_B(C) = \frac{m_2}{n - 2} = \frac{10}{58} = \frac{5}{29}.$$

Three questions were taken, so the total number of questions is $n - 3$, the number of questions that the student does not know is $m_2 - 1$. The conditional probability of the occurrence of event D is:

$$P_C(D) = \frac{m_2 - 1}{n - 3} = \frac{9}{57}.$$

The required probability is:

$$P(A \text{ and } B \text{ and} C \text{ and } D) = \frac{5}{6} \cdot \frac{49}{59} \cdot \frac{5}{29} \cdot \frac{9}{27} = \frac{11025}{277182} = 0{,}04$$

Answer: $P(A \text{ and } B \text{ and} C \text{ and } D) = 0.04$.

4.3 List of practical skills that a student should possess after mastering the discipline.

- use educational, scientific, popular science, reference literature, and the Internet;
- predict and interpret research results;
- solve typical practical problems;
- solve situational problems based on theoretical knowledge;
- solve simple differential equations;
- determine point and interval estimates of the parameters of the general population based on the sample;
- solve medical and biological problems using methods of correlation and regression analysis;
- present the results of experiments (measurements) graphically;
- use software packages for statistical data processing and mathematical modeling;
- work on a personal computer as a user;
- make basic physical measurements, process the measurement results and use computing tools for this purpose;
- work on electromedical equipment, the study of which is provided for in the work program;
- perform the simplest analysis of data obtained using medical equipment (plotting the electrical axis of the heart, analyzing the rheogram, plethysmogram, electromyogram, etc.);

4.4 List of questions for the credit-test

1. What is sound? Characteristics of tones, noises, sound impacts.
2. Objective (physical) characteristics of sound.
3. Subjective characteristics of sound, their connection with objective ones.
4. The threshold of hearing and the threshold of pain. Their value at a frequency of 1 kHz.
5. Weber-Fechner law.
6. Air and bone conduction of sound.
7. What is audiometry, audiogram?
8. Sound research methods: auscultation, percussion, phonocardiography.
9. Pulse current. Pulse current parameters.
10. The effect of direct current on the organs and tissues of the body.
11. The impact of low-frequency pulsed and alternating currents on body tissues.
12. Treatment methods and equipment based on the use of low and sound frequency pulsed currents.
13. Physical processes occurring in the tissues of the body under the influence of high-frequency fields and currents.
14. The effect of an alternating electric field on conductors and dielectrics.
15. The effect of an alternating magnetic field
16. UHF therapy. Inductothermy.
17. Treatment methods based on the use of ultra-high frequency (UHF) electromagnetic fields.
18. CMV therapy (microwave therapy).
19. DCV (DMV) - therapy.
20. Electrosurgery.
21. Treatment with currents of supratonal frequency.
22. Darsonvalization.
23. How does the resistance of metals and semiconductors depend on temperature and why?
24. What is a thermistor? Its purpose.
25. What is thermistor calibration?
26. Describe the structure of a DC bridge. What is called a bridge arm?
27. Balanced and unbalanced bridge.
28. Derive a formula for determining resistance using a DC bridge.
29. How to measure unknown resistance using bridge circuit?
30. Alternating current (definition, graphical dependence of current or voltage on time).
31. Active, inductive and capacitive resistance in an AC circuit.
32. Impedance of an AC circuit. Resonance. Resonant frequency.
33. Why do biological tissues have dielectric and conductive properties?
34. Impedance of living and dead tissue. Its components. Graph of impedance dependence on frequency.
35. Equivalent electrical circuit of biological tissue (living and dead).
36. Rheography. Biophysical foundations of the rheography method. What law is the rheography method based on?
37. Rheogram. Draw a rheogram and indicate on it the areas characteristic of the contraction and relaxation phases of the heart. How will the electrical resistance of an organ or tissue change during the cardiac cycle?

38. Clinical significance of the rheography method.
39. Sensors of medical and biological information, definition, classification.
40. Types of generator sensors and their operating principle.
41. Types of parametric sensors and their operating principle.
42. Biophysical principles of plethysmography.
43. The concept of photoplethysmography.
44. Physical principles for determining the speed of propagation of a pulse wave.
45. Analysis of the factors on which the speed of propagation of the pulse wave depends.
46. Clinical significance of plethysmography.
47. Mechanism of formation of extracellular excitation potential. What is called a biphasic action potential?
48. Biophysical foundations of electrography. What is an electrogram? Its varieties. The principle of electrogram registration.
49. Electric dipole, its characteristics and properties.
50. The Heart as an Electric Dipole. What is an Electrocardiogram?
51. The concept of the integral electrical vector of the heart (IEVH).
52. Einthoven's triangle. Standard ECG leads.
53. What teeth does the ECG of a healthy person consist of?
54. What does the amplitude of the teeth and their interval characterize? What does the algebraic sum of the teeth " Q ", " R ", " S " express?
55. Rules for applying electrodes.
56. What is light absorption? Bouguer's law formula for light absorption, its physical meaning.
57. What is the natural absorption rate, what does it depend on?
58. The formula of the Bouguer-Lambert-Beer law, its physical meaning.
59. What is transmittance, optical density?
60. What is concentration colorimetry?
61. What physical quantities are measured directly using concentration colorimetry methods?
62. The concept of electromyography.
63. Biophysical foundations of electrography.
64. Mechanism of electromyogram formation.
65. Medical information recording devices. Electrodes.
66. Types of electrodes and requirements for them.
67. Derivative of a function of one variable: definition, notation, table of derivatives of elementary functions.
68. Differential of a function: definition, notation, formula for finding it. Expression of the derivative of a function through the differentials of the function and argument.
69. Indefinite integral: definition, notation, table of basic integrals.
70. The concept of a differential equation: definition, general notation, order of the equation.
71. General and particular solutions of differential equations.
72. General form of a first order differential equation with separable variables. Plan for its solution.
73. The concept of drawing up differential equations (using an example).
74. Basic concepts of probability theory: random event, probability of an event (definition, example). Relative frequency of an event.
75. Certain event (definition, example). Probability of a certain event.

76. Impossible event (definition, example). Probability of an impossible event.
77. Incompatible events. Compatible events. (Definition, example).
78. Complete system of events (definition, example).
79. Opposite events (definition, example).
80. Rule of addition of probabilities.
81. Consequences following from the rule of addition of probabilities.
82. Independent events. Dependent events (definition, example).
83. Conditional probability (definition, example).
84. The rule of multiplication of probabilities.
85. Random variable. Continuous random variable. Discrete random variable.
86. Distribution of a discrete random variable and its characteristics: mathematical expectation, variance
87. What is mathematical statistics?
88. General population. Sample.
89. Statistical series. Histogram. Frequency polygon.
90. Arithmetic mean of random variables.
91. Standard deviation of random variables.
92. Error of the arithmetic mean.
93. Confidence interval. Confidence probability.
94. Recording the final results of the experiment.
95. The criterion for the reliability of the difference between the arithmetic means of two samples.
96. Correlation analysis, definition.
97. Functional connection, definition, examples.
98. Correlation relationship, definition, examples.
99. Correlation coefficient, formula, basic properties.
100. The criterion of reliability of the correlation coefficient, its purpose.