


Ministry of science and high education RF Ulyanovsk State University	Form	
F-Educational plan of the discipline		

**APPROVED BY**  
by the decision of the Academic Council of the USU  
Institute of Medicine, Ecology and Physical Culture



Record No. 9/239 \_\_\_\_\_  
Chairman М.И. Визе-Хрипунова  
(Signature, Name)

« 18 » May 2022.

### EDUCATIONAL PLAN

Discipline	<b>Physics , mathematics</b>
Faculty	Medical faculty of T.Z. Biktimirov
Name of department	<b>Department of Physical Methods in Applied Researches</b>
Course	<b>1</b>

Direction (specialty) 31.05.01 General medicine

the code of the direction (specialty), full name

Orientation (profile/specialty) not provided

full name

Form of training \_\_\_\_\_ full-time \_\_\_\_\_

full-time, part-time, part-time (specify only those that are being implemented)

Date of introduction into the academic process at Ulyanovsk State University

« 1 » 09 2022

Revised at the Department meeting, Record No. \_\_\_\_\_ of \_\_\_\_\_ « \_\_\_\_\_ » 20\_\_

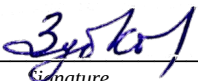

Revised at the Department meeting, Record No. \_\_\_\_\_ of \_\_\_\_\_ « \_\_\_\_\_ » 20\_\_


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Revised at the Department meeting, Record No. \_\_\_\_\_ of \_\_\_\_\_ « \_\_\_\_\_ » 20\_\_

Information about the authors:

Initials	Abbreviation of the department	Degree, scientific rank
<b>Eliseeva S.V.</b>	<b>Department of Physical Methods in Applied Researches</b>	<b>Ph.D., Associate Professor</b>

Agreed	Agreed
Head of department, developing discipline	Head of the graduating Department
 /Yu.N. Zubkov/ _____ Signature Full name	 /Mize-Khripunova M.A./ _____ Signature Full name
« 09 » 06 2022 г.	« 09 » 06 2022 г.

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## 1. OBJECTIVES AND AIM OF Physics , mathematics

### The purpose of mastering the discipline:

formation of medical students systematic knowledge of the physical laws and processes in biological objects, understanding of the device and the operation of medical equipment, qualified use of mathematical methods to solve educational, scientific, diagnostic and medical tasks, necessary, both for training in other academic disciplines, and for the direct formation of a specialist in the field of General Medicine.

### The main objectives of the discipline are:

1. the study of basic physical concepts and laws to explain the processes taking place in biological systems;
2. study the features of manifestations of the laws of physics in the body;
3. obtaining ideas about the possibilities of using technical devices in medicine, their types and principles of work;
4. the formation of representations on the application of physical laws to justify the use of medical equipment;
5. students mastering mathematical methods and forming practical skills of statistical processing of experimental material;
6. safety training for students working with medical equipment.

## 2. PLACE OF THE SUBJECT IN THE STRUCTURE OF GEP:


Discipline is mandatory and applies to the base of Block B1 «Disciplines (modules)» of the basic professional educational programs (BPEP), established by the university.

Discipline is read in the first 1 st semester of the course full-time students and is based on knowledge in the subjects of physics and mathematics in the volume of the school program. In particular, in physics, one needs to know the basic laws of mechanics, electrodynamics, optics, the basic principles of molecular kinetic theory, have ideas about mechanical and electromagnetic vibrations and waves, and about the structure of an atom and atomic nucleus. Finally, students should be familiar with the currently accepted SI system of units.

In mathematics, you need: knowledge - rules of action with fractions, degrees, logarithms; trigonometric functions; concepts of derivative and primitive, indefinite and definite integral, rules of differentiation and integration, tabular derivatives and primitives; ability to build graphics; Skills in calculating the simplest derivatives and integrals.

The results of mastering the discipline will be necessary for the further learning process as part of the phased formation of competencies in the study of the following special disciplines:

1. «Anatomy»
2. «Latin language»
3. «Philosophy»
4. «Biology»
5. «Chemistry»
6. «Biochemistry»
7. «Topographic anatomy and operative surgery»
8. «Radiation diagnostics»
9. «Neuroanatomy»
10. «Informatics (medical)»

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11. «Modern medical information systems»
12. «Modern biomedical technologies»
13. «Nanotechnology in medicine»
14. «Microbiology, Virology»
15. «Propaedeutics of internal diseases»
16. «Hygiene»
17. «Startup Management in Social Entrepreneurship»
18. «Preparation for passing and state exam»

### 3.LIST OF EXPECTED RESULTS OF INSTRUCTION ON THE SUBJECT (UNIT), CORELATED WITH PLANNED RESULTS OF COMPLETING THE PROGRAM

The study of the subject «» within the completion of the educational program is directed towards the formation of the following general and professional competences in students:

Code and name of the general professional competence

**General competence-1-**

The ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy

Code and name of the indicator of achievement of general professional competence

**To know:** mathematical methods for solving intellectual problems and their application in medicine;

**To be able to:** carry out statistical processing of experimental data, analyze and summarize the results obtained in the process of professional activity;

**To own:** skills of modeling physical processes in biological systems.

**General professional competence-10-**

The ability to understand the principles of operation of modern information technologies and use them to solve problems of professional activity


**To know:** the theoretical foundations of modern research methods, the principles of operation of physical devices used in medicine; biophysical mechanisms of action of physical factors on a living organism.

**To be able to:** make a plan and determine the objectives of the study; apply basic methods and techniques for measuring physical parameters, assessing the physical properties of biological objects; evaluate the accuracy of the selected measurement method, based on mathematical methods of processing the obtained data.

**To own:** skills of using the conceptual and functional apparatus in the field of natural sciences; skills of argumentation when choosing a method or equipment for solving professional problems.

#### 4.Volume of the subject

4.1. Volume of the subject in credit points (total): 3 credit points


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#### 4.2. On types of academic workload (in hours): 108


Type of academic work	Number of hours (form of education __full-time course__)		
	Total according to the plan	Including on semesters	
		No semester 1	No semester 6
1	2	3	4
Work of students with a teacher	54	54	
Classes:	54	54	
lectures	18	18	
practical classes and seminars	-	-	
lab classes (practical lessons)	36	36	
Self-study work	54	54	
Concurrent control (number and type: a test, a colloquium, a report)	-	Testing, oral questioning on control questions of laboratory work, a written report on laboratory work	
Course paper	-		
Types of intermediate attestation (examination, test)		test	
Total number of hours on the subject	<b>108</b>	<b>108</b>	

#### 4.3. Contents of the discipline (module). Distribution of hours on themes and kinds of study: Number of hours 108–h The form of training: full time

Title of sections and topics	Total	Types of Training				
		Auditory lessons			including interactive classes	Students' Individual Work
		lectures	seminars and practices	laboratory works		
1	2	3	4	5	6	7
<b>Section 1. (Mechanics)</b>						
1. The basic laws of mechanics.	6	1	-	4	-	1
2. Mechanical vibrations and waves. Acoustics.	6	1	-	3	-	1
<b>Section 2. (Elements of fluid mechanics)</b>						
3. Properties of liquids.	5	1	-	2	-	2
4. The movement of bodies in liquids	5	1	-	4	-	2

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and gases						
<b>Section 3. (Molecular Physics. Thermodynamics)</b>						
5. The basics of molecular physics.	6	1	-	3	-	2
6. The laws of thermodynamics.	7	1	-	3	-	2
<b>Section 4. (Transfer processes in biological systems)</b>						
7. Passive and active transport of matter.	6	1	-	3		2
8. Biopotentials.	7	1	-	3	-	2
<b>Section 5. (Electromagnetic Oscillations and waves)</b>						
9. Alternating current.	5	1	-	2	-	2
10. Electromagnetic waves.	6	1	-	2	-	2
<b>Section 6. (Wave and geometric optics)</b>						
11. Interference and diffraction of light waves.	6	1	-	3	-	2
12. The laws of geometric optics.	8	1	-	4	-	2
<b>Section 7. (Thermal radiation and absorption)</b>						
13. Thermal radiation from the body	5	1	-	2	-	2
14. The laws of absorption. Colorimetry.	6	1	-	3	-	2
<b>Section 8. (Physics of Atoms and Molecules)</b>						
15. The structure of atoms and molecules.	6	1	-	3	-	2
16. Radioactivity. Dosimetry.	3	1	-	2	-	2
<b>Section 9. (Basic concepts of quantum mechanics)</b>						
17. Elements of quantum mechanics.	3	1	-	2	-	2
18. Lasers.	6	1		3		2
<b>Section 10. (Elements of higher mathematics)</b>						
19. The basic concepts of mathematical analysis.	3	-	-	2	-	1
20. Integration rules and methods	3	-	-	2	-	1

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for solving differential equations.						
<b>Total</b>	<b>108</b>	<b>18</b>	-	<b>36</b>	-	<b>54</b>

If it is necessary to use partially or exclusively distance learning technologies in the educational process, it should be noted that the total number of hours (c.u.) set by the Department of discipline/specialty for each discipline/practice remains unchanged and is implemented in full. In this case, in the corresponding section of the educational program the total number of hours of work with students in accordance with the educational plan is allocated and the number of hours for conducting classes in a remote format using e-learning (online courses, lectures and seminars in videoconference mode, virtual practical classes, laboratory work in the form of virtual analogues, calculation and graphic works, individual tasks in the electronic information and educational environment, etc.) Training and industrial practice for all areas of discipline/specialties of all forms of training can be partially or fully implemented in a remote format.

## 5. COURSE CONTENT

### Section 1. Mechanics

#### Theme 1. Basic laws of mechanics

Fundamental interactions in nature. The law of gravity. The force of gravity. Body weight. Inert and gravitational mass. Cosmic speeds. Friction. The nature of friction. Types of friction. Elastic and deformation forces. Hooke's law. Mechanical work. Kinetic and potential energy. The law of conservation and transformation of energy in mechanics. Moment of power. Moment of momentum. The law of conservation of angular momentum. The law of the dynamics of the rotational motion of a rigid body relative to a fixed axis. The moment of inertia of the body.

#### Theme 2. Mechanical vibrations and waves. Acoustics

Harmonic vibrations. Differential equations of harmonic oscillations. The energy of an oscillating body. Damped oscillations. Differential equations of damped oscillations. Forced vibrations. Resonance. Self-oscillations. Additions of harmonic oscillations. Mechanical waves. Wave equation. The flow of wave energy. Intensity, Umov vector. Sound. Physical characteristics of a sound wave, their relationship with the physiological characteristics of sound perception. Ultrasound. Sources and receivers of ultrasound. The use of ultrasound in pharmacy and medicine.


### Section 2. Elements of fluid mechanics

#### Theme 3. Properties of liquids

The movement of an ideal fluid. The equation of continuity. Bernoulli equation. Flow pressure. Viscous liquid. Body Wrap Lifting power. Viscous fluid flow. Internal friction. Reynolds number. Poiseuille formula. Forces acting on a body in a stream. Stokes formula. Methods for determining the viscosity of a liquid.

#### Theme 4. Transfer processes in biological systems

The basic equation of diffusion. Fick's equation. The diffusion equation for a membrane. The concept of electrochemical potential. Diffusion in ideal gases and solutions. Theorell equation. The transfer of ions through the membrane. The Nernst-Planck equation. Types of transport through the membrane. Energy conversion diffusion.

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### **Section 3. Molecular Physics. Thermodynamics**

#### **Theme 5. Fundamentals of molecular physics**

The main provisions of the molecular kinetic theory. Molecular forces. Differences in the molecular structure of gases, liquids and solids. Phase transitions. Amorphous bodies, glassy state, liquid crystals, polymers. Perfect gas. The basic equations of the molecular-kinetic theory of an ideal gas. The internal energy of an ideal gas and an ideal crystal. Boltzmann distribution. Gas liquefaction.

#### **Theme 6. Laws of thermodynamics**

The first law of thermodynamics. The work done by an ideal gas in various processes. Change in the internal energy and heat capacity of an ideal gas in various processes, Mayer's equation. The heat capacity of an ideal crystal. The second law of thermodynamics. Thermodynamic probability and entropy. Entropy and heat transfer. Heat and mass transfer. The equation of diffusion, thermal conductivity, viscosity. Application in pharmaceutical technologies.

### **Section 4. Transfer processes in biological systems**

#### **Theme 7. Passive and active transport of matter**

The basic equation of diffusion. Fick's equation. The diffusion equation for a membrane. The concept of electrochemical potential. Diffusion in ideal gases and solutions. Theorell equation. The transfer of ions through the membrane. The Nernst-Planck equation. Types of transport through the membrane. Energy conversion diffusion.

#### **Theme 8. Biopotentials**

Bioelectric potentials. Ionic streams. The potential for rest. Action potential. The electric field of the dipole. Dipole in an external electric field. Registration of biopotentials. Einthoven Lead Theory. Cardiography.

### **Section 5. Electromagnetic Oscillations and Waves**

#### **Theme 9. Alternating current**

Alternating current. Excitation of electromagnetic waves. Inductive, capacitive and impedance in the AC circuit. Ohm's law in an alternating current circuit. Resonance in the AC circuit. AC power. Electrical conductivity of biological tissues. The effect of current on body tissues. High-frequency current physiotherapy methods.

#### **Theme 10. Electromagnetic waves**

Electromagnetic field. Electromagnetic waves. Maxwell's equations. Energy characteristics of an electromagnetic wave. Scale of electromagnetic waves. Human exposure to electromagnetic radiation. The use of electromagnetic fields in medicine. Physical foundations of mass spectrometry.

### **Section 6. Wave and geometric optics**

#### **Theme 11. Interference and diffraction of light waves**

Light interference. Coherence. Jung's experience. Interference in thin films. Enlightenment of optics. Interferometers and their use in pharmacology.


Diffraction of waves. Huygens-Fresnel principle. Diffraction on a slit in parallel beams. Diffraction grating. Diffraction spectroscopy in pharmacology.

Polarization of light. Natural and polarized light. The law of Malus. Birefringence polarization of light. Rotation of the plane of polarization. Polarimetry in pharmacy.

#### **Theme 12. Laws of geometric optics**

Basic concepts of geometric optics. Lenses. The formula of the lens. Magnifier. Optical microscopy. The device of the microscope. Formula to increase. Resolution.

Refraction and reflection of light. Full internal reflection. Refractometry, its use in

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pharmacology. Fiber optics.

### **Section 7. Thermal radiation and absorption**

#### **Theme 13. Thermal radiation of bodies**

Characteristics of thermal radiation. Black body. Kirchhoff's Law. Planck formula. The laws of Stefan-Boltzmann, Wines. The radiation of the sun. Infrared and ultraviolet radiation and their use in medicine. Radiation of the human body. The use of thermography for diagnostic purposes.

#### **Theme 14. Laws of absorption. Colorimetry**

Absorption and scattering. The Bouguer-Lambert-Beer Act. Concentration colorimetry in pharmacy. Photoelectric colorimeters.

### **Section 8. Physics of Atoms and Molecules**

#### **Theme 15. The structure of atoms and molecules**

The structure of the electron shells of the atom. Quantum numbers. Theory of Bohr. Wave properties of particles. Emission and absorption spectra.

#### **Theme 16. Radioactivity. Dosimetry**

The structure of the nucleus of an atom. Nuclear Forces. The binding energy of the nucleus. Radioactivity. The law of radioactive decay. Labeled atoms, their use in pharmacy and medicine. Dosimetry of ionizing radiation. The effect of ionizing radiation on matter and the body. Methods for recording ionizing radiation. Dosimeters. Protection against ionizing radiation.

### **Section 9. Basic concepts of quantum mechanics**

#### **Theme 17. Elements of quantum mechanics**

Schrödinger equation. Quantum-mechanical model of the atom. Luminescence. Mechanisms and types of luminescence: photoluminescence, chemiluminescence, photobiological processes. Electron microscopy.

#### **Theme 18. Lasers**

Spontaneous and induced radiation. Creation of the inverse population. The principle of operation of an optical quantum generator. The property of laser radiation. The use of lasers in pharmacy.

### **Section 10. Mathematics**

#### **Theme 19. Elements of higher mathematics**

Basic concepts of mathematical analysis. Derivatives and differentials.

#### **Theme 20. Integration rules**

Calculations of indefinite and definite integrals. Methods for solving first-order differential equations with separating variables.


## **6. TOPICS OF PRACTICAL CLASSES AND SEMINARS (FOR DISCUSSING AND SELF-PREPARING OF STUDENTS)**

This type of work is not provided by training program.

## **7. LABORATORY CLASSES**

### **Section 1. Mechanics**



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### **Theme 1. Accurate weighing**

Methods of accurate weighing, determination of body weight on technical and analytical scales. Calculation of errors of direct measurements.

### **Theme 2. Mathematical and physical pendulums**

The study of the work of the revolving pendulum and the determination of the acceleration of gravity. Assimilation of the concepts of weightlessness, overloads. The mechanics of the musculoskeletal system of a person (the basic equation of the dynamics of rotational motion).

### **Theme 3. Determination of the ear hearing by the threshold method**

Learning the basics of acoustics. Familiarization with the work of the speech and hearing apparatus of a person. Mastering the diagnostic method of the hearing aid. Determining the boundaries of the range of frequencies perceived by the ear; determination of the threshold of sound perception for different frequencies; Audiogram construction - dependence of threshold volume levels in dB on frequency.

## **Section 2. Elements of fluid mechanics**

### **Theme 4. Determination of the viscosity of liquids**

Studying the properties of liquids. Determination of the viscosity of liquids with an Ostwald viscometer and the Stokes method.

### **Theme 5. Measurement of blood pressure by Korotkov's method**

Study of the human circulatory system model. The study of the tonometer (mechanical and electronic). Mastering the method for determining the pressure of the circulatory system in humans. Bernoulli equation.

## **Section 3. Molecular Physics. Thermodynamics**

### **Theme 6. Determination of the ratio $C_p/C_v$ and sound velocity in air by acoustic resonance**

Studying the laws of an ideal gas, familiarization with the resonant method for determining the speed of sound in air using the standing wave method.

### **Theme 7. Determination of specific heat and specific heat of water vaporization, checking the heat balance equation**

The study of the method for determining the specific heat of water and the specific heat of vaporization; experimental verification of the heat balance equation.

## **Section 4. Transfer processes in biological systems**

### **Theme 8. The study of the properties of biological membranes**

The Fick equation, Nernst-Planck equation. Study of transfer processes on a membrane model with a methylene blue solution. The study of passive transport.

### **Theme 9. Research of biopotentials of the heart using an electrocardiograph**

The study of biopotentials and the foundations of the Einthoven theory. Mastering the skills of taking an electrocardiogram using a portable electrocardiograph.


## **Section 5. Electromagnetic Oscillations and Waves**

### **Theme 10. The study of the thermal effect of RF therapy**

Studying the process of interaction of HF radiation with biological objects. The study of methods of HF therapy: darsonvalization, diathermy, inductothermy, UHF therapy. Measurement of the spatial distribution of the HF field.

## **Section 6. Wave and geometric optics**

### **Theme 11. The study of the microscope and its application for the study of biological objects**

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The study of the optical scheme of the microscope. The course of the rays in a thin lens. The study of the optical system of the human eye. The concept of aperture, linear and angular magnification, aberration.

**Theme 12. Determination of the refractive index of liquids using a refractometer**

The study of the laws of geometric optics. The phenomena of total internal reflection. Mastering the method for determining the concentration of solutions using a refractometer.

**Section 7. Thermal radiation and absorption**

**Theme 13. Photoelectric method for determining the concentration of solutions**

The theory of scattering and absorption of light. The study of the law of absorption of light. Mastering the method for determining the concentration of solutions using a photolorimeter.

**Section 8. Physics of Atoms and Molecules**

**Theme 14. Measurement of resistivity of a thin wire**

The study of the mechanism of conductivity of metals, solutions, gases. Determination of the active resistance of a metal conductor from the measured values of current and voltage; measurement of the geometric dimensions of the conductor; resistivity calculation.

**Theme 15. Determination of sugar concentration using a saccharimeter**

Optical activity of molecules. Mastering the method for determining the concentration of sugars in solutions. Optical design of a saccharimeter. Birefringence, polarization, rotation of the plane of polarization by optically active media. Specific rotation.

**Раздел 9. Основные представления о квантовой механике**

**Theme 16. The study of the properties of laser radiation and light diffraction**

Studying the principle of the helium-neon laser. OKG device. The concept of inverse population. The study of the law of Malus, the phenomenon of diffraction.

**Section 10. Mathematics**

**Theme 19. Elements of higher mathematics**

Homogeneous linear differential equations of the first order.

Basic concepts of mathematical analysis. Derivatives and differentials.

**Theme 20. Integration rules**


The main properties of the indefinite integral. Table of integrals. Replacing a variable in an indefinite integral. Integration by parts in an indefinite integral. Defined integral, its geometric and mechanical meaning.

**8. SUBJECTS OF COURSE PAPERS, TESTS, ESSAYS**


This type of work is not provided by training program.

**9. QUESTIONS FOR EXAM ON DISCIPLINE “PROPEDEUTICS OF INTERNAL DISEASES”**


1. Periodic processes. Basic concepts of periodic processes. Free oscillations. Equation of oscillations of a spring pendulum.
2. Damped oscillations. Equation of oscillations of a spring pendulum. Forced vibrations. Resonance.
3. The energy of undamped harmonic oscillations. Self-oscillations. Fluctuations in the

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- human body. Vibrations.
4. Basic concepts of a mechanical wave. Longitudinal and transverse waves. Wave front. Speed and wavelength. The equation of a plane wave. Energy flow. Umova vector.
  5. Varieties of waves: surface waves, excitation waves in active media, shock waves. Standing wave. The equation of a standing wave.
  6. Doppler effect and its use in medicine.
  7. Acoustics. Sound, types of sound. Physical characteristics of sound. Characteristics of auditory sensation. Sound measurements.
  8. Physics of hearing. Sound-conducting and sound-receiving parts of the hearing aid. Determination of localization of a sound source in horizontal and vertical planes.
  9. Physical characteristics of sound. Characteristics of auditory sensation. Weber-Fechner Law. Audiometry Sound research methods in medicine.
  10. Ultrasound. Sources and receivers of ultrasound. Features of the propagation of ultrasonic waves. The use of ultrasound in the diagnosis. The effect of ultrasound on the substance, cells and tissues of the body.
  11. Infrasound, features of its distribution. Biophysical basis of the action of infrasound. Vibrations.
  12. Properties of liquids. Internal friction (viscosity) of a fluid. Newton's equation. Blood as a non-Newtonian fluid.
  13. The condition of continuity of the jet. Laminar turbulent flow. Reynolds number.
  14. Bernoulli equation.
  15. Viscous fluid flow in cylindrical tubes. Poiseuille formula. Pressure distribution during the flow of real fluid through pipes of constant, variable cross-sections.
  16. Mechanical properties of biological tissues: bones and blood vessels, muscle tissue.
  17. Blood circulation model. Shock volume of blood. Dependence of the propagation velocity and pressure on the parameters of the vessel in the circulatory system. Korotkov method.
  18. Characteristics of the heart. Work and power of the heart.
  19. Diffusion in gases and liquids. Fick's diffusion equation.
  20. The diffusion equation for a membrane. Determination of electrochemical potential.
  21. Diffusion in electrolytes. Transport equation for electrochemical potential (Theorell equation).
  22. The transfer of ions in an electrolyte in the presence of an electric field. The Nernst-Planck equation.
  23. Modes of transport: passive and active. Energy conversion diffusion.
  24. Basic concepts of thermodynamics. The first law of thermodynamics. The heat capacity of the substance.
  25. Application of the first law of thermodynamics to isoprocesses and biological systems.
  26. The Entropy. The second law of thermodynamics. The third law of thermodynamics.
  27. Heat exchange. Types of heat transfer: equations of heat conduction, convection, radiation. The energy balance of the body. Heat treatment. Methods of obtaining low temperatures.

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28. Bioelectric potentials. Ionic streams. The potential for rest. Goldman-Hodgkin-Katz equation. Action potential.
29. Electric dipole. The electric field of the dipole. Dipole in an external electric field (in homogeneous and inhomogeneous).
30. Electrocardiography. Einthoven Theory.
31. Electrical conductivity of biological tissues and liquids for direct current. Measurement methods. Primary processes in tissues during galvanization and therapeutic electrophoresis.
32. The magnetic properties of the substance. Classification of magnets: para-, di-, ferromagnets. The concept of magnetobiology and biomagnetism. Magnetic field therapy.
33. Alternating current. Excitation of electromagnetic waves. Capacitive, inductive and impedance in an alternating current circuit. Phase relations of current and voltage.
34. Ohm's law for an alternating current circuit. Resonance in the AC circuit. Electric pulse and pulse current. Pulse electrotherapy.
35. Electromagnetic wave. Maxwell's equations, their solution.
36. Energy characteristics of an electromagnetic wave. Scale of electromagnetic waves. Classification of frequency intervals, adopted in medicine. Human exposure to electromagnetic radiation.
37. The nature of light. Basic concepts of light waves. Huygens-Fresnel principle.
38. Wave interference. The condition for the appearance of maxima and minima in the interference pattern. Methods of observing the phenomenon of interference (Jung's experiment).
39. Light interference. Enlightenment of optics. Interferometers and their use in medicine.
40. Diffraction of light on a slit in parallel rays. Diffraction grating. Diffraction spectrum.
41. Diffraction of electromagnetic waves in spatial structures. Wulf-Bragg Formula Fundamentals of X-ray diffraction analysis.
42. The light is natural and polarized. The degree to which light passes through the polarizer. The law of Malus.
43. Methods of obtaining polarized light. Prism Nicolas.
44. Rotation of the plane of polarization. Polarimetry. The study of biological tissues in polarized light.
45. The concept of the beam. Laws of reflection and refraction. Refractometry
46. The phenomenon of total internal reflection. Fiber optics, its use in medical devices. Endoscope.
47. Lenses. Beam path in collecting and scattering lenses. Lens Formulas The optical power of the lens.
48. The structure of the eye. The optical system of the eye. Accommodation. Binocular vision. Myopia and farsightedness.
49. Microscopy. The optical system of the microscope. Magnification, resolution, microscope.
50. Thermal radiation. Black body. Kirchhoff's Law. The Law of Wine. Stefan-Boltzmann Law. The radiation of the sun. The basics of thermography.

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51. Light absorption. Booger's Law. Concentration colorimetry. Phototherapy.
52. Wave properties of particles. Wave de Broglie. Electron diffraction. Uncertainty relation. Discreteness of energy states.
53. Luminescence. Mechanisms and types of luminescence. Stokes rule. The use of luminescence in biology and medicine.
54. Lasers Creation of the inverse population. The principle of the laser. Properties of laser radiation. The use of lasers in biological research and in medicine.
55. The structure of the nucleus of an atom. Nuclear Forces. The binding energy of the nucleus.
56. Radioactivity. The law of radioactive decay. The main types of radioactive decay.
57. Biophysical basis of the action of ionizing radiation on the body. Dosimetry.
58. X-ray radiation. Sources of radiation. Braking and characteristic radiation. The use of x-rays in medicine.
59. The main properties of the indefinite integral. Table of integrals.
60. Replacing a variable in an indefinite integral.
61. Integration by parts in an indefinite integral.
62. A definite integral, its geometric and mechanical meaning.
63. Homogeneous linear differential equations of the first order.

## 10. SELF-STUDY WORK OF STUDENTS


The content, requirements, conditions and procedure for organizing students 'individual work, taking into account the form of training, are determined in accordance with the "Regulation on the organization of students' independent work", approved by the Academic Council of UISU (protocol №8/268 from 26.03.2019 year.).

Mode of study: **full-time**

<b>Title of sections and themes</b>	<b>Type of individual work</b> <i>(study of educational material, problem solving, abstract, report, test, preparation for passing the test, exam, etc.)</i>	<b>Volume in hours</b>	<b>Form of control</b> <i>(verification of problem solving, abstract, etc.)</i>
1. The basic laws of mechanics.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	1	testing, oral survey credit
2. Mechanical oscillations and waves. Acoustics.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> </ul>	1	testing, oral survey credit


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	<ul style="list-style-type: none"> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>		
3. Properties of liquids.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
4. The movement of bodies in liquids and gases	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
5. The basics of molecular physics.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
6. The laws of thermodynamics.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
7. Passive and active transport of matter.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> </ul>	2	testing, oral survey credit

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	<ul style="list-style-type: none"> <li>• Preparing for credit</li> </ul>		
8. Biopotentials.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
9. Alternating current.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
10. Electromagnetic waves.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
11. Interference and diffraction of light waves.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
12. The laws of geometric optics.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	2	testing, oral survey credit
13. Thermal radiation from the body	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information</li> </ul>	2	testing, oral survey credit



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	<ul style="list-style-type: none"> <li>support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> <li>Preparation for testing;</li> <li>Preparing for credit</li> </ul>		
14. The laws of absorption. Colorimetry.	<ul style="list-style-type: none"> <li>Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> <li>Preparation for testing;</li> <li>Preparing for credit</li> </ul>	2	testing, oral survey credit
15. The structure of atoms and molecules.	<ul style="list-style-type: none"> <li>Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> <li>Preparation for testing;</li> <li>Preparing for credit</li> </ul>	2	testing, oral survey credit
16. Radioactivity. Dosimetry	<ul style="list-style-type: none"> <li>Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> <li>Preparation for testing;</li> <li>Preparing for credit</li> </ul>	2	testing, oral survey credit
17. Elements of quantum mechanics.	<ul style="list-style-type: none"> <li>Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> <li>Preparation for testing;</li> <li>Preparing for credit</li> </ul>	2	testing, oral survey credit
18. Lasers.	<ul style="list-style-type: none"> <li>Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>Preparation of materials based on the results of laboratory and practical classes;</li> </ul>	2	testing, oral survey credit



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	<ul style="list-style-type: none"> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>		
19. The basic concepts of mathematical analysis.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	1	testing, oral survey credit
20. Integration rules and methods for solving differential equations.	<ul style="list-style-type: none"> <li>• Development of educational material using the resources of educational and methodological and information support of the discipline;</li> <li>• Preparation of materials based on the results of laboratory and practical classes;</li> <li>• Preparation for testing;</li> <li>• Preparing for credit</li> </ul>	1	testing, oral survey credit

## 11. EDUCATIONAL AND METHODOLOGICAL AND INFORMATION SUPPORT OF DISCIPLINE

List of recommended literature:


### main:

- 1 Remizov, A. N. Medical and biological physics : textbook / Remizov A. N. - Москва : ГЭОТАР-Медиа, 2021. - 576 с. - ISBN 978-5-9704-5943-0. - Текст : электронный // ЭБС "Консультант студента" : [сайт]. - URL : <https://www.studentlibrary.ru/book/ISBN9785970459430.html>
- 2 Касюк С. Т. Physics : textbook / С. Т. Касюк, Н. В. Маркина. - Челябинск : ТЕТА, 2021. - 276 с. - Текст : электронный // ЭБС "Букап" : [сайт]. - URL : <https://www.books-up.ru/ru/book/physics-12914752/>
3. Козлов А. И. Biological physics = Биологическая физика : lectures for the 1st - year students of a pharmaceutical faculty / А. И. Козлов. - Витебск : ВГМУ, 2021. - 191 с. - ISBN 9789855800706. - Текст : электронный // ЭБС "Букап" : [сайт]. - URL : <https://www.books-up.ru/ru/book/biological-physics-13855642/>

### additional literature:

1. Ключин В. Л. Mathematics : Textbook For Students Majoring In Non Mathematical Subjects / В. Л. Ключин. - М. : Издательство РУДН, 2019. - 669 с. - Текст : электронный // ЭБС "Букап" : [сайт]. - URL : <https://www.books-up.ru/ru/book/mathematics-9361079/>



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1.6. ЭБС Znanium.com : электронно-библиотечная система : сайт / ООО Знаниум. - Москва, [2022]. - URL: <http://znanium.com> . – Режим доступа : для зарегистрир. пользователей. - Текст : электронный.

1.7. Clinical Collection : научно-информационная база данных EBSCO // EBSCOhost : [портал]. – URL: <http://web.b.ebscohost.com/ehost/search/advanced?vid=1&sid=9f57a3e1-1191-414b-8763-e97828f9f7e1%40sessionmgr102> . – Режим доступа : для авториз. пользователей. – Текст : электронный.

1.8. База данных «Русский как иностранный» : электронно-образовательный ресурс для иностранных студентов : сайт / ООО Компания «Ай Пи Ар Медиа». – Саратов, [2022]. – URL: <https://ros-edu.ru>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

**2. КонсультантПлюс** [Электронный ресурс]: справочная правовая система. /ООО «Консультант Плюс» - Электрон. дан. - Москва : КонсультантПлюс, [2022].

### **3. Базы данных периодических изданий:**

3.1. База данных периодических изданий EastView : электронные журналы / ООО ИВИС. - Москва, [2022]. – URL: <https://dlib.eastview.com/browse/udb/12>. – Режим доступа : для авториз. пользователей. – Текст : электронный.

3.2. eLIBRARY.RU: научная электронная библиотека : сайт / ООО Научная Электронная Библиотека. – Москва, [2022]. – URL: <http://elibrary.ru>. – Режим доступа : для авториз. пользователей. – Текст : электронный

3.3. Электронная библиотека «Издательского дома «Гребенников» (Grebinnikon) : электронная библиотека / ООО ИД Гребенников. – Москва, [2022]. – URL: <https://id2.action-media.ru/Personal/Products>. – Режим доступа : для авториз. пользователей. – Текст : электронный.

**4. Федеральная государственная информационная система «Национальная электронная библиотека»** : электронная библиотека : сайт / ФГБУ РГБ. – Москва, [2022]. – URL: <https://нэб.рф>. – Режим доступа : для пользователей научной библиотеки. – Текст : электронный.

**5. SMART Imagebase** : научно-информационная база данных EBSCO // EBSCOhost : [портал]. – URL: <https://ebSCO.smartimagebase.com/?TOKEN=EBSCO-1a2ff8c55aa76d8229047223a7d6dc9c&custid=s6895741>. – Режим доступа : для авториз. пользователей. – Изображение : электронные.

### **6. Федеральные информационно-образовательные порталы:**

6.1. Единое окно доступа к образовательным ресурсам : федеральный портал . – URL: <http://window.edu.ru/> . – Текст : электронный.

6.2. Российское образование : федеральный портал / учредитель ФГАУ «ФИЦТО». – URL: <http://www.edu.ru>. – Текст : электронный.

### **7. Образовательные ресурсы УлГУ:**

7.1. Электронная библиотечная система УлГУ : модуль «Электронная библиотека» АБИС Мега-ПРО / ООО «Дата Экспресс». – URL: <http://lib.ulsu.ru/MegaPro/Web>. – Режим доступа : для пользователей научной библиотеки. – Текст : электронный.

AGREED:


*Зам. науч. библиот.* / *Ключкова М. В.*

The position of the worker scientific library

Full name

signature

data

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## 12. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Multimedia auditorium with a capacity of more than 60 people. Multimedia audience consists of integrated engineering systems with a single control system, equipped with modern means of reproduction and visualization of any video and audio information, the receipt and transmission of electronic documents.

The multimedia audience package consists of: a multimedia projector, an automated projection screen, an acoustic system, and an interactive tribune for the teacher, including a touch screen monitor, personal computer, conference microphone, wireless microphone, equipment control unit, connection interfaces: USB, audio, HDMI . The teacher's interactive platform is a key control element that combines all devices into a single system and serves as a full-time teacher's workplace. The teacher has the ability to easily manage the entire system without leaving the rostrum, which allows lectures, workshops, presentations, conferences and other types of classroom workload of students in a convenient and accessible form for them using modern interactive teaching tools, including using learning process of all corporate resources. The multimedia audience is also equipped with broadband Internet access. Computer hardware has the appropriate licensed software.

Laboratory work is carried out in subgroups in two classrooms of a physical workshop for medical students for 16 people, equipped with all the requirements for physical laboratories. Workplaces are designed to perform a physical practical work of two students at the same time.

### Used laboratory equipment

A set of laboratory equipment for carrying out work in mechanics: a set of bodies, weights, technical scales, electronic analytical scales, calipers and micrometers, Ostwald viscometers, medical tonometers, an audiometer, mathematical and physical pendulums.

Molecular physics and thermodynamics equipment includes: an acoustic resonance unit, an apparatus for determining the heat capacity of liquids and verification of the heat balance equation;

The following equipment is used to study the phenomena of transfer: a device for determining the electrical properties of conductors, electrocardiographs, and RF therapy devices.


A complex of laboratory equipment for carrying out optics: lasers, refractometers, polarimeters, saccharimeters, microscopes, photo-calorimeters.

In laboratory physical practical personal computers connected to the broadband network INTERNET.

## 13. SPECIAL CONDITIONS FOR STUDENTS WITH DISABILITIES

Training students with disabilities is carried out taking into account the peculiarities of psychophysical development, individual capabilities and health of such students. Education of students with disabilities can be organized in conjunction with other students, and separately. If necessary, students from among persons with disabilities (at the request of the student) may be offered one of the following options for the perception of information, taking into account their individual psychophysical characteristics:

- for persons with visual impairment: in printed form in large print; in the form of an electronic document; in the form of an audio file (translation of educational materials into audio format); in printed form in Braille; individual consultations with the involvement of a tiflosurdoperevodchika; individual tasks and consultations.
- for persons with hearing impairment: in printed form; in the form of an electronic document;

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video materials with subtitles; individual consultations with the assistance of a sign language interpreter; individual tasks and consultations.

- for persons with musculoskeletal disorders: in printed form; in the form of an electronic document; in the form of an audio file; individual tasks and consultations."

**Developer**

  
\_\_\_\_\_  
(signature)

**lecturer**

(position)

**S.V. Eliseeva**

(name)