



APPROVED

Vice-Rector for Academic Affairs

E.S. Bogomolova

31 August 2021

WORKING PROGRAM

Name of the academic discipline: **BIOPHYSICS**

Specialty: **31.05.01 GENERAL MEDICINE**

Qualification: **GENERAL PRACTITIONER**

Department: **MEDICAL BIOPHYSICS**

Mode of study: **FULL-TIME**

Labor intensity of the academic discipline: **72 academic hours**

The working program has been developed in accordance with the Federal State Educational Standard for specialty 31.05.01 GENERAL MEDICINE approved by Order of the Ministry of Science and Higher Education of the Russian Federation No. 988 of August 12, 2020.

Developers of the working program:

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D.I. Iydin, Ph.D. (Physical and Mathematical Sciences), Ph.D. (Biology), Professor, Head of the Department of Medical Biophysics of Federal State Budgetary Educational Institution of Higher Education «Privolzhsky Research Medical University» of the Ministry of Health of the Russian Federation

The program was reviewed and approved at the department meeting of the Department of Medical Biophysics (protocol No. 9, April 15, 2021)

Head of the Department of Medical Biophysics,

Ph.D. (Physical and Mathematical Sciences), Ph.D. (Biology),

Professor

(signature)



D.I. Iydin

April 15, 2021

AGREED

Deputy Head of EMA

ph.d. of biology



Lovtsova L.V.

(signature)

April 15, 2021

1. The purpose and objectives of mastering the academic discipline «Biophysics» (hereinafter – the discipline):

1.1. **The purpose of mastering the discipline:** participation in the formation of UC-1 competencies consists in the formation of students' ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy.

1.2. Tasks of the discipline:

- formation of students of the medical faculty of systemic knowledge about the physical properties and processes occurring in biological objects, including the human body, necessary both for solving biomedical problems and for the direct formation of a specialist;
- development and formation of skills of biophysical analysis of biological systems in the process of laboratory research;
- study of sections of applied physics, which consider the principles of operation and capabilities of medical equipment used in diagnosis and treatment;
- formation of students' knowledge about the laws of biophysics, physical methods of studying biological objects, experience in using knowledge about mathematical and statistical methods of solving intellectual problems and their application in medicine;
- formation of skills and abilities to use physical equipment for the effective application of biophysical methods in research and diagnostics; knowledge of safety regulations when working with medical equipment;
- teaching students safety techniques when working with medical equipment.

1.3. Requirements to the deliverables of mastering the discipline

As a result of completing the discipline, the student should

Know:

- abstract thinking methodology for systematization of quantitative and qualitative characteristics of the physiological state of the organism and the environment;
- methodology of measurement of physical characteristics of a biological object;
- electrical processes occurring in the body, electrical and magnetic properties of biological media: physical foundations of electrocardiography, electrical conductivity of biological tissues, physical foundations of magnetobiology, rheography.

Be able to:

- to identify objective, physical processes in biological systems and determine their relationship with the fundamental laws of physics;
- to evaluate the resolution and resolution limit of an optical microscope, to characterize the properties of images obtained in a lens, eyepiece, microscope;
- use analog and digital measuring instruments to measure the mechanical properties of liquids, electrical and optical characteristics of biological objects, dosimetry.

Possess:

- abstract thinking methodology for making conclusions about the results of measurements of physical characteristics of biological objects and mathematical processing of the data obtained;
- the method of measuring physical quantities using analog and digital measuring instruments.

2. Position of the academic discipline in the structure of the General Educational Program of Higher Education (GEP HE) of the organization.

2.1. The discipline «Biophysics» refers to the core part of Block 1 (C.1.1.57) of GEP HE. The discipline is taught in 3 semester/2year of study.

2.2. The following knowledge, skills and abilities formed by previous academic disciplines are required for mastering the discipline:

- physics, mathematics, biology in the scope of secondary general school education,
- physics, mathematics.

2.3. Mastering the discipline is required for forming the following knowledge, skills and abilities for subsequent academic disciplines: physiology, biochemistry, microbiology and virology, hygiene, ophthalmology, public health and healthcare, oncology, radiation diagnostics and radiation therapy.

3. Deliverables of mastering the academic discipline and metrics of competence acquisition

Mastering the discipline aims at acquiring the following universal (UC) or/and general professional (GPC) or/and professional (PC) competencies

№	Competence code	The content of the competence (or its part)	Code and name of the competence acquisition metric	As a result of mastering the discipline, the students should:		
				know	be able to	possess
1.	UC-1	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	<u>ID-1 CC-1.1.</u> Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis <u>ID-2 CC-1.2.</u> Able to: gain new knowledge based on analysis, synthesis, etc.; collect data on complex scientific problems related to the professional field; search for information and solutions based on action, experiment and experience	methods of systematic and critical analysis; methods of developing action strategies for identifying and solving a problem situation	apply the methods of a systematic approach and critical analysis of problem situations; develop a strategy of actions, make concrete decisions for its implementation	methodology of systematic and critical analysis of problem situations; methodology of goal setting, determination of ways to achieve it, development of action strategies.

** Competence achievement indicator – a set of planned learning outcomes in disciplines (modules) and practices that ensure the formation of all graduate competencies established by the specialty program.*

These are generalized characteristics that clarify and reveal the formulation of competence in the form of specific actions performed by a graduate who has mastered this competence. Indicators should be comparable to labor functions and/or labor actions (professional standard), but not equal to them. Indicators of competence achievement should be measured using the means available in the educational process.

4. Sections of the academic discipline and competencies that are formed when mastering them:

№	Competence code	Section name of the discipline	The content of the section in teaching units
1.	UC-1	Biomechanics	Mechanical properties of biological tissues. Biomechanics of the musculoskeletal system: biomechanical properties of skeletal muscles, remodeling of bone tissue as the basis of its strength, biomechanics of skeletal joints. Biomechanics of the circulatory system: rheological properties of blood, basic laws of hemodynamics; elements of biomechanics of the heart, biophysical patterns of blood flow through the vessels, pulse wave, Frank model.
2.	UC-1	Molecular physics, thermodynamics	Thermodynamics of biological objects. Temperature. Thermometry. Warmth. The first beginning of thermodynamics. Application of the first principle of thermodynamics to living organisms. The energy balance of the body, methods of heat exchange. Types of thermoregulation. The second beginning of thermodynamics. Entropy. Prigozhin's theorem. Surface tension. Wettability. Capillarity. Humidity.
3.	UC-1	Physical processes in biological membranes.	The structure of the membranes. The main functions of biological membranes. Mechanical and electrical properties of membranes. Membrane models. Mobility of phospholipid molecules in membranes: lateral diffusion, flip-flop transitions. Physical state and phase transitions of lipids in membranes.
4.	UC-1	Biophysics of transport processes and formation of biopotentials.	Types of passive transport. Equations: Fika, Theorella, Nernst-Planck. The concept of electrochemical potential. Types of active transport. ATP-bases, their functions. The role of active transport in maintaining the potential of rest. Active transport, like EMF. Equivalent electrical circuit of a biological membrane. Physical methods of registration of biopotentials. Microelectrode technology. Equilibrium potentials: (Donnan, Nernst potentials). Stationary potential (Goldman-Hodgkin-Katz potential). Methods of measuring action potentials. Ion channels of biological membranes. The action potential of a neuron. Propagation of the action potential. Mechanism of generation of cardiomyocyte action potential. The telegraphic equation.
5.	UC-1	Electrical properties of organs and tissues of the human body. Physical processes in tissues when exposed to current and electromagnetic fields.	Passive electrical properties of living tissues. Impedance measurement. The impedance of living tissues. External low-frequency EMF of tissues, organs, biophysical fundamentals of electrocardiography. The primary effect of direct current on the tissues of the body. Interaction of the electrical component of the electromagnetic field with the body: - biological effect of low frequency EMF; - biological effect of high-frequency EMF (diathermy, darsonvalization, inductothermy, laser therapy, UHF therapy, microwave therapy). Frequency-dependent biological effects of EMF.
6.	UC-1	Optics, microscopy methods.	Biophysics of vision. The optical system of the eye and its features. Disadvantages of the optical system of the eye and their compensation. Special microscopy methods. Microscopy methods. Polarimetry. Optical anisotropy in living tissues. Thermal radiation of bodies. Characteristics of thermal radiation. Black body. Kirchoff's law. The laws of black body radiation. Heat transfer of the body. The concept of thermography. Infrared radiation and its application in medicine. Ultraviolet radiation and its application in medicine.
7.	UC-1	Quantum biophysics.	Types of luminescence. Stokes' law for photoluminescence. Chemiluminescence, mechanisms of its generation, application in biomedical analysis. Luminescence spectra. Spectrofluorimeter.
8.	UC-1	Interaction of ionizing radiation with matter. Dosimetry.	Physical fundamentals of radiology. The use of X-ray radiation in medicine. Physical fundamentals of medical tomography. The structure of the massive anode of X-ray tubes. Computed tomography. Interaction of ionizing radiation with matter. The physical basis of the action of ionizing radiation on the body. Dosimetry.

5. Volume of the academic discipline and types of academic work

Type of educational work	Labor intensity		Labor intensity (AH) in semester
	volume in credit units (CU)	volume in academic hours (AH)	semester 3
Classroom work, including	1,2	44	72
Lectures (L)	0,3	10	10
Laboratory workshops (LP)	<i>FSES are not provided</i>		
Practical practicum (PZ)	0,9	34	34
Practicals (P)	<i>FSES are not provided</i>		
Seminars (S)	<i>FSES are not provided</i>		
Student's individual work (SIW)	0,8	28	28
Mid-term assessment			
CREDIT			
TOTAL LABOR INTENSITY	2	72	72

6. Content of the academic discipline

6.1. Sections of the discipline and types of academic work

№	Semester No.	Name of the section of the academic discipline	Types of academic work* (in AH)					
			L	LP	P	S	SIW	total
1.	3.	Biomechanics.	1		6		2	9
2.	3.	Molecular physics, thermodynamics.	1		4		3	8
3.	3.	Physical processes in biological membranes.	1				3	4
4.	3.	Biophysics of transport processes and formation of biopotentials.	1		6		3	10
5.	3.	Electrical properties of organs and tissues of the human body. Physical processes in tissues when exposed to current and electromagnetic fields.	2		8		4	14
6.	3.	Optics, microscopy methods.	2		6		3	11
7.	3.	Quantum biophysics.	1				7	8
8.	3.	Interaction of ionizing radiation with matter. Dosimetry.	1		4		3	8
		CREDIT						
		TOTAL	10		34		28	72

* - L – lectures; LP – laboratory practicum; P – practicals; S – seminars; SIW – student's individual work.

6.2. Thematic schedule of educational work types:

6.2.1. Thematic schedule of lectures

№	Name of lecture topics	Volume in AH
		Semester 3
1.	Mechanical properties of biological tissues. Biomechanics of the musculoskeletal system. Biomechanics of the circulatory system.	1
2.	Temperature. Thermometry. Warmth. The first beginning of thermodynamics. Application of the first principle of thermodynamics to living organisms. The energy balance of the body, methods of heat exchange.	0,5
3.	Surface tension. Wettability. Capillarity. Humidity.	0,5
4.	The structure of membranes. The main functions of biological membranes. Mechanical and electrical properties of membranes. Membrane models.	1
5.	Types of passive transport. Equations: Fick, Theorell, Nernst-Planck. The concept of electrochemical potential. Types of active transport. Physical methods of registration of biopotentials. Equilibrium potentials: (Donnan, Nernst potentials). Stationary potential (Goldman-Hodgkin-Katz potential). Methods of measuring action potentials. Ion channels of biological membranes.	1
6.	Passive electrical properties of living tissues. The impedance of living tissues. External low-frequency EMF of tissues, organs, biophysical fundamentals of electrocardiography. Biological effect of low and high frequency EMF.	2
7.	Medical microscopy. Special microscopy techniques.	2
8.	Types of luminescence. Stokes's law for photoluminescence. Chemiluminescence.	1
9.	Interaction of ionizing radiation with matter. The physical basis of the action of ionizing radiation on the body. Dosimetry.	1
10.	TOTAL (total – 10 AH)	10

6.2.2. The thematic plan of laboratory practicums

- *FSES are not provided.*

6.2.3. Thematic plan of practicals

	Name of laboratory practicums	Volume in AH
		Semester 3
1	Mechanical properties of biological tissues.	2
2	Determination of the molecular weight of biomolecules by a viscometer.	2
3	Measurement of the viscosity coefficient of a liquid with a medical viscometer.	2
4	Measurement of the surface tension coefficient by the Rebinde method.	2
5	Determination of air humidity.	2
6	Modeling of biophysical processes. Simulation of the resting potential.	2
7	Modeling of biophysical processes. Modeling the potential of action.	2
8	Modeling of biophysical processes. Pharmacokinetic model.	2
9	Passive electrical properties of tissues.	2
10	The physical foundations of high- and low-frequency therapy.	2
11	Study of the electric dipole field.	2
12	Physical basics of electrocardiography.	2
13	Medical polarimetry.	2
14	Concentration colorimetry.	2
15	Microscopy. Special microscopy techniques.	2
16	Study of the law of radioactive decay. Dosimetry.	2
17	Physical and technical fundamentals of radiology.	2
	TOTAL (total – 34 AH)	34

6.2.4. Thematic plan of seminars

- *FSES are not provided.*

6.2.5. Types and topics of student's individual work (SIW)

№	<i>Types and topics of SIW</i>	Volume in AH
		semester 3
1	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "Biomechanics. Physical foundations of hemodynamics. Models of blood circulation. Determination of blood flow velocity". HW, DEW</i>	2
2	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "The second beginning of thermodynamics. Entropy. Prigozhin's theorem". HW, DEW</i>	3
3	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "Membrane models. Mobility of phospholipid molecules in membranes: lateral diffusion, flip-flop transitions. Physical state and phase transitions of lipids in membranes". HW, DEW</i>	3
4	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "The action potential of a neuron. Propagation of the action potential. Mechanism of generation of cardiomyocyte action potential. The telegraphic equation". HW, DEW</i>	3
5	<i>Work with literary and other sources of information on the section under study; work with electronic educational resources posted on the educational portal of the University - "External low-frequency EMF of tissues, organs. Frequency-dependent biological effects of EMF". HW, DEW</i>	2
6	<i>Work with literary and other sources of information on the section under study; work with electronic educational resources posted on the educational portal of the University - "Electrical properties of organs and tissues of the human body. Physical processes in tissues when exposed to current and electromagnetic fields". HW, DEW</i>	2
7	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "The optical system of the eye. Polarization of light. Methods of obtaining polarized light. Polarization microscopy. Optical activity. Polarimetry". HW, DEW</i>	3
8	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "Energy characteristics of light streams, flux: the flux of light radiation and the flux density (intensity). Light scattering. Light absorption. The Booger-Lambert-Baer law. Optical density.".</i>	2
9	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "Optical spectra of atoms and molecules. Spectrophotometry." HW, DEW</i>	3
10	<i>Work with literary and other sources of information on the studied section; work with electronic educational resources posted on the educational portal of the University - "Luminescence. Stokes' law for photoluminescence. Luminescence spectra. Luminescent microscopy. Chemiluminescence."</i>	2
11	<i>Work with literary and other sources of information on the section under study; work with electronic educational resources posted on the educational portal of the University; preparation for the boundary control, including work with electronic educational resources (computer testing in on-line mode on the website of distance education of the University (HW, DEW) - "Braking X-ray radiation. The spectrum of braking radiation. Physical fundamentals of medical tomography. The structure of the massive anode of X-ray tubes. Computed tomography."</i>	3
	TOTAL (total – 28 AH)	28

***Types of independent work: work with literary and other sources of information on the section under study, including in an interactive form, homework (HW), work with electronic educational resources posted on the educational portal of the University, distance education website (DEW), etc.*

7. Types of assessment formats for ongoing monitoring and mid-term assessment

№	Se- mes- ter No.	Types of control		Name of section of academic discipline	Competen- ce codes	Assessment formats		
						types	number of test questions	number of test task options
1.	3	Current moni- toring	Control of mastering the topic	Biomechanics.	UC-1	Test	30	20 - Computer testing (the variant is formed by random sampling)
			Monito- ring the student's individual work			Testing of practical skills.	3	20
						Interview	2	50
						Writing a test paper (or preparing an audio report)	8	45
2.	3	Current moni- toring	Control of mastering the topic	Molecular physics, thermodyna- mics.	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
			Monito- ring the student's individual work			Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	50
						Writing a report on an individual task (or preparing an audio report).	20	12
3.	3	Current moni- toring	Control of mastering the topic	Physical processes in biological membranes.	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
			Monito- ring the student's individual work			Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
4.	3	Current moni- toring	Control of mastering the topic	Biophysics of transport processes and formation of biopotentials.	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
			Monito- ring the student's individual work			Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
5.	3	Current moni- toring	Control of mastering the topic	Electrical properties of organs and tissues of the human body. Physical processes in	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
							Current testing. Control work.	6

			Monitoring the student's individual work	tissues when exposed to current and electromagnetic fields.		Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
6.	3	Current monitoring	Control of mastering the topic	Optics, microscopy methods.	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Monitoring the student's individual work			Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
7.	3	Current monitoring	Control of mastering the topic	Quantum biophysics.	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Monitoring the student's individual work			Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
8.	3	Current monitoring	Control of mastering the topic	Interaction of ionizing radiation with matter. Dosimetry.	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Monitoring the student's individual work			Current testing. Oral individual survey.	20	30
						Writing a report on an individual task (or preparing an audio report).	20	12
9.	3	Mid-term assessment	CREDIT	All sections	UC-1	Test tasks.	200	Computer testing (the variant is formed by random sampling)
						Oral individual survey.	4	12

8. Educational, methodological and informational support for mastering the academic discipline (printed, electronic publications, the Internet and other network resources)

8.1. Key literature references

№	Name according to bibliographic requirements	Number of copies	
		at the department	in the library
1.	Raymond A. Serway, John W. Jewett . Physics for Scientists and Engineers with Modern Physics, 10th Edition, 2019.- 1254 p.		
2.	Miles Hudson. Pearson Edexcel International Advanced Level (IAL) Physics Student Book and ActiveBook 1, 2018.- 224 p.		
3.	Miles Hudson. Pearson Edexcel International Advanced Level (IAL) Physics Student Book and ActiveBook 2, 2018.- 224 p.		
4.	Michael Nelkon. Advanced Level Physics, 7th Edition, 1996.- 960 p.		

8.2. Further reading

№	Name according to bibliographic requirements	Number of copies	
		at the department	in the library
1.	Malinovskaya S.L., Iyidin D.I., Drygova O.V. Physics problem book. – Nizhny Novgorod: Publishing House of Privolzhsky Research Medical University, 2023.- 116 p.		
2.	Malinovskaya S.L., Iyidin D.I., Drygova O.V. Physics and Biophysics problem book – Nizhny Novgorod: Publishing House of Privolzhsky Research Medical University, 2023.- 112 p.		
3.	Monich V.A. Physics and medical physics. – Nizhny Novgorod: Publishing House of Privolzhsky Research Medical University, 2018.- 116 p.		
4.	Monich V.A. Medical physics and biological problems. – Nizhny Novgorod: Publishing by Nizhny Novgorod State Medical Academy, 2009.- 68 p.		

8.3. Electronic educational resources for teaching academic subjects

8.3.1. Internal Electronic Library System of the University (IELSU)

№	Name of the electronic resource	Brief description (content)	Access conditions	Number of users
	Internal Electronic Library System (EBS)	The works of the academic staff of the Academy: textbooks and manuals, monographs, collections of scientific papers, scientific articles, dissertations, abstracts of dissertations, patents.	from any computer located on the Internet, using an individual login and password [Electronic resource] – Access mode: http://95.79.46.206/login.php	Not limited

8.3.2. Electronic educational resources acquired by the University

№	Name of the electronic resource	Brief description (content)	Access conditions	Number of users
1.	Electronic database "Student Consultant"	Educational literature + additional materials (audio, video, interactive materials, test tasks) for higher medical and pharmaceutical education. Publications are structured by specialties and disciplines in accordance with the current Federal State Educational Standards of Higher Education.	from any computer located on the Internet, using an individual login and password [Electronic resource] – Access mode: http://www.studmedlib.ru/	General PIM subscription
2.	Electronic library system "Bukap"	Educational and scientific medical literature of Russian publishers, including translations of foreign publications.	from any computer located on the Internet by login and password, from the computers of the academy. The publications for which a subscription is issued are available for reading. [Electronic resource] – Access mode: http://www.books-up.ru/	General PIM subscription
3.	"Bibliopoisk"	Integrated "single window" search service for electronic catalogs, EBS and full-text databases. The results of a single search in the demo version include documents from domestic and foreign electronic libraries and databases available to the university as part of a subscription, as well as from open access databases.	PIM has access to the demo version of the Bibliopoisk search engine: http://bibliosearch.ru/pimu .	General PIM subscription

4.	Domestic electronic periodicals	Periodicals on medical subjects and on higher school issues	- from the academy's computers on the electronic library platform eLIBRARY.RU -magazines Media Sphere Publishing house - from library computers or provided by by the library at the request of the user [Electronic resource] – Access mode: https://elibrary.ru/	
5.	International scientometric database "Web of Science Core Collection"	Web of Science covers materials on natural, technical, social, and humanitarian sciences; takes into account the mutual citation of publications developed and provided by Thomson Reuters; has built-in capabilities for searching, analyzing, and managing bibliographic information.	Access is free from PIM computers [Electronic resource] – Access to the resource at: http://apps.webofknowledge.com	Access is free from PIM computers

8.3.3 Open access resources

<i>Name of the electronic resource</i>	<i>Brief description (content)</i>	<i>Access conditions</i>
Federal Electronic Medical Library (FEMB)	It includes electronic analogues of printed publications and original electronic publications that have no analogues recorded on other media (dissertations, abstracts, books, magazines, etc.). [Electronic resource] – Access mode: http://nel.ru/	from any computer located on the Internet
Scientific Electronic Library eLIBRARY.RU	The largest Russian information portal in the field of science, technology, medicine and education, containing abstracts and full texts of scientific articles and publications. [Electronic resource] – Access mode: https://elibrary.ru/	from any computer located on the Internet.
Open Access Scientific Electronic Library CyberLeninka	Full texts of scientific articles with annotations published in scientific journals of Russia and neighboring countries. [Electronic resource] – Access mode: https://cyberleninka.ru/	from any computer located on the Internet
Russian State Library (RSL)	Abstracts for which there are copyright agreements with permission for their open publication [Electronic resource] – Access mode: http://www.rsl.ru/	from any computer located on the Internet
Legal reference system "Consultant Plus"	Federal and regional legislation, judicial practice, financial advice, comments on legislation, etc. [Electronic resource] – Access mode: http://www.consultant.ru/	from any computer located on the Internet
Official website of the Ministry of Health of the Russian Federation	National clinical guidelines. [Electronic resource] – Access mode: cr.rosminzdrav.ru - Clinical recommendations	from any computer located on the Internet
Official website of the Russian Respiratory Society	Modern materials and clinical recommendations for the diagnosis and treatment of respiratory diseases [Electronic resource] – Access mode: www.spulmo.ru – Russian Respiratory Society	from any computer located on the Internet
Official website of the Russian Scientific Society of Therapists	Modern materials and clinical recommendations for the diagnosis and treatment of diseases of internal organs [Electronic resource] – Access mode: www.rnmot.ru – Russian Scientific Society of Therapists	from any computer located on the Internet

9. Material and technical support for mastering an academic discipline

9.1. List of premises for classroom activities for the discipline

9.1.1. For lectures there are:

- BFC lecture halls (large and small halls);
- lecture hall of the Morphological Building;
- lecture hall of dormitory No. 3;
- lecture hall of building No. 9.

9.1.2. For practical training on the basis of building No. 2 there is:

- 4 specially equipped rooms (classrooms) for seminars and practical classes in the study of disciplines;
- 4 display classes.

9.2. List of equipment for classroom activities for the discipline:

9.2.1. Classrooms equipped with:

educational boards, educational furniture, teaching materials, PC, overhead projector, multimedia projector, laptop, Internet access.

9.2.2. A set of experimental equipment:

1. Laboratory scales SC 2020.
2. Analytical scales ALC-80d4.
3. Dosimeters.
4. The conductometer is portable.
5. PWT conductometer tester.
6. Lasers.
7. Luxmeters.
8. Multimeter 2000 E.
9. Biological microscopes.
10. Headphones.
11. Pulse oximeter.
12. pH meters.
13. IRF-464 refractometers (with backlight).
14. Installations for studying the phenomena of the photoelectric effect.
15. Photoelectrocolorimeters KFK-3.

16. Personal computers TCN.
17. BENQ monitors.
18. Laser printer.
19. Laptops.

20. Video lectures.
21. Videos for laboratory work.
22. Presentations of lectures.

**laboratory, instrumental equipment (specify which one), multimedia complex (laptop, projector, screen), TV, video camera, slide show, video recorder, PC, video and DVD players, monitors, sets of slides, tables/multimedia visual materials on various sections of the discipline, videos, whiteboards, etc.*

9.3. Set of licensed and freely distributed software, including domestic production

<i>№</i>	<i>Software</i>	<i>Number of licenses</i>	<i>Type of software</i>	<i>Manufacturer</i>	<i>Number in the unified register of Russian software</i>	<i>№ and contract date</i>
1.	Wtware	100	Thin Client Operating System	Kovalev Andrey Alexandrovich	1960	2471/05-18 of 28.05.2018
2.	My Office Is Standard. A corporate user license for educational organizations, with no expiration date, with the right to receive updates for 1 year.	220	Office Application	LLC " NEW CLOUD TECHNOLOGIES "	283	without limitation, with the right to receive updates for 1 year.
3.	LibreOffice		Office Application	The Document Foundation	Freely distributed software	
4.	Windows 10 Education	700	Operating systems	Microsoft	Subscription Azure Dev Tools for Teaching	
5.	Yandex.Browser		Browser	LLC «YANDEX»	3722	
6.	Subscription to MS Office Pro for 170 PCs for the FSBEI HE PRMU MOH Russia	170	Office Application	Microsoft		23618/HH100 30 LLC "Softline Trade " of 04.12.2020

10. List of changes to the working program (to be filled out by the template)

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation
(FSBEI HE "PRMU" of the Ministry of Health of Russia)

Department of
MEDICAL BIOPHYSICS

CHANGE REGISTRATION SHEET

working program for the academic discipline
BIOPHYSICS

Field of study / specialty / scientific specialty: _____
(code, name)

Training profile: _____
(name) - for master's degree programs

Mode of study: _____
full-time/mixed attendance mode/extramural

Position	Number and name of the program section	Contents of the changes made	Effective date of the changes	Contributor's signature
1				

Approved at the department meeting
Protocol No. _____ of _____ 20__

Head of the Department

department name, academic title

signature

print name