



APPROVED
Vice-Rector for Academic Affairs
E.S. Bogomolova
31 August 2021

WORKING PROGRAM

Name of the academic discipline: **MEDICAL PHYSICS**

Specialty: **31.05.03 DENTISTRY**

Qualification: **DENTIST**

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 31.05.03 DENTISTRY approved by Order of the Ministry of Science and Higher Education of the Russian Federation No. 984 of August 12, 2020.

Developers of the working program:

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S.L. Malinovskaya, Ph.D. (Biology), Professor 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



D.I. Iydin

(signature)

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 « Medical Physics» (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 logical thinking among students of the medical faculty, the ability to accurately formulate a task, the ability to isolate the main and secondary, the ability to draw conclusions based on the obtained measurement results;
- acquisition by students of the ability to draw conclusions based on the obtained measurement results;
- study of sections of applied physics, which consider the principles of operation and capabilities of medical equipment used in diagnosis and treatment;
- teaching students mathematical methods that are used in medicine and allow them to extract the necessary information from the results of observations and measurements, to assess the degree of reliability of the data obtained;
- formation of skills for studying scientific literature;
- training of students in safety when working with electronic and optical equipment.

1.3. Requirements to the deliverables of mastering the discipline

As a result of completing the discipline, the student should

Know:

- methodology of abstract thinking for systematization of quantitative and qualitative characteristics of the physiological state of the organism and the environment;
- methodology for measuring the physical characteristics of a biological object.

Be able to:

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

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;
- methods for measuring physical quantities using analog and digital measuring instruments, methods for estimating errors of direct and indirect measurements.

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 « Medical physics » refers to the core part of Block 1 (B1.E.9) of GEP HE. The discipline is taught in 1st and 2nd semesters, 1 year of study.

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

- school physics course,

- school math course.

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, public health, 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	<p><u>ID-1 UC-1.1</u> Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis.</p> <p><u>ID-2 UC-1.2</u> Can: acquire new knowledge based on analysis, synthesis; collect data on complex scientific problems related to the professional field; search for information and solutions based on actions, experiment and experience.</p> <p><u>ID-3 UC-1.3</u> Has practical experience: research of professional activity samples with the use of analysis, synthesis and other methods of intellectual activity; development of an action strategy for solving professional problems.</p>	methodology of abstract thinking for systematization of quantitative and qualitative characteristics of the physiological state of the organism and the surrounding environment.	to gain new knowledge based on analysis, synthesis, to identify objective, physical processes in biological systems and to determine their connection with the fundamental laws of physics.	the methodology of abstract thinking for making conclusions about the results of measurements of the physical characteristics of biological objects and mathematical processing of the data obtained.

* 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 disciplines	The content of the section in didactic units
1.	UC-1	Biomechanics	Bioacoustics. Biophysics of hearing. Biological effect of infrasound waves. Physical foundations of the Korotkov sound method. Physical fundamentals of medical ultrasound application. Physical fundamentals of hemodynamics. Medical materials science. Mechanical properties of biological tissues. Surface tension and viscosity of biological fluids.
2.	UC-1	Molecular physics, thermodynamics	Thermodynamics of biological objects. Thermodynamics of open systems. Humidity.
3.	UC-1	Electrical properties of organs and tissues of the human body, the effect of electromagnetic fields	Passive electrical properties of living tissues. Impedance measurement. The impedance of living tissues. The effect of the UHF electromagnetic field on dielectric conductors. Low-frequency therapy.
4.	UC-1	Medical optics	Medical polarimetry. Optical anisotropy in living tissues. Medical microscopy.
5.	UC-1	Physical fundamentals of medical introscopy	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.

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

Type of educational work	Labor intensity		Labor intensity (AH) in semesters	
	volume in credit units (CU)	volume in academic hours (AH)	semester 1	semester 2
<i>Classroom work, including</i>	<i>1,2</i>	<i>44</i>	<i>22</i>	<i>22</i>
Lectures (L)	0,3	12	6	6
Laboratory practicum (LP)	<i>FSES are not provided</i>			
Practical (P)	0,9	32	16	16
Seminars (S)	<i>FSES are not provided</i>			
<i>Student's individual work (SIW)</i>	<i>0,8</i>	<i>28</i>	<i>14</i>	<i>14</i>
Mid-term assessment				
CREDIT				
TOTAL LABOR INTENSITY	2	72	36	36

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)					total
			L	LP	P	S	SIW	
1.	1	Biomechanics	4		10		4	18
2.	1	Molecular physics, thermodynamics			3		6	9
3.	1,2	Electrical properties of organs and tissues of the human body, the effect of electromagnetic fields	2		6		8	16
4.	2	Medical optics	3		10		4	17
5.	2	Physical fundamentals of medical introscopy	3		3		6	12
		CREDIT						
		TOTAL	12		32		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	semester 1	semester 2
1.	Bioacoustics.	1,5	
2.	Physical fundamentals of medical ultrasound application.	1	
3.	Physical foundations of the Korotkov sound method.	0,5	
4.	Physical fundamentals of hemodynamics.	1	
5.	Passive electrical properties of human body tissues.	1	
6.	Physical foundations of rheography.	1	
7.	Medical microscopy.		3
8.	Physical fundamentals of radiology. Application X-ray radiation in medicine.		2
9.	Physical fundamentals of medical tomography.		1
	TOTAL (total – 12 AH)	6	6

6.2.2. The thematic plan of laboratory practicums

- FSES are not provided.

6.2.3. Thematic plan of practicals

№	Name of practical classes	Volume in AH	
		semester 1	semester 2
1.	Medical materials science.	5	
2.	Mechanical properties of biological tissues.	3	
3.	Determination of the molecular weight of biomolecules by a viscometer.	4	
4.	Measurement of the viscosity coefficient by a medical viscometer.	4	
5.	Humidity of the air.		2
6.	Temperature measurement with a thermocouple, thermistor.		2
7.	Passive electrical properties of tissues.		3
8.	The effect of the UHF electromagnetic field on dielectrics, conductors.		3
9.	Medical polarimetry.		3
10.	Concentration colorimetry.		3
	TOTAL (total – 32 AH)	16	16

6.2.4. Thematic plan of seminars

- FSES are not provided.

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

n/a	Types and topics of SRS*	Volume in AH	
		Semester 1	Semester 2
1.	Biophysics of hearing. Biological effect of infrasound waves. <i>HW, DEW</i>	4	
2.	Entropy of open systems. Thermodynamic equilibrium. <i>HW, DEW</i>	6	
3.	Equivalent electrical circuits of living tissues. <i>HW, DEW</i>	4	4
4.	Optical anisotropy in living tissues. <i>HW, DEW</i>		4
5.	Computed tomography. <i>HW, DEW</i>		6
	TOTAL (total – 28)	14	14

**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.

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

№	Semester No.	Types of control	Name of section of academic discipline	Competence codes	Assessment formats			
					types	number of test questions	number of test task options	
1.	1	Current monitoring	Control of mastering the topic	Biomechanics	UC-1	Test	30	20 - Computer testing (the variant is formed by random sampling)
						Testing of practical skills.	3	20
						Interview	2	50
						Writing a test paper (or preparing an audio report)	8	45
2.	1	Current monitoring	Control of mastering the topic	Molecular physics, thermodynamics	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
						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.	1	Current monitoring	Control of mastering the topic	Electrical properties of organs and tissues of the human body, the effect of electromagnetic fields	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	30

			Monitoring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
4.	1	Current monitoring	Control of mastering the topic	Medical optics	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Current testing. Oral individual survey.			20	30	
			Monitoring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
5.	1	Current monitoring	Control of mastering the topic	Physical fundamentals of medical introscopy.	UC-1	Test tasks. Oral individual survey.	30	Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Current testing. Oral individual survey.			20	20	
			Monitoring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
6.	1	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., Iydin D.I., Drygova O.V. Physics problem book. – Nizhny Novgorod: Publishing House of Privolzhsky Research Medical University, 2023.- 116 p.		
2.	Malinovskaya S.L., Iydin 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://нэб.рф/	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	Subscrip-tion 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
MEDICAL PHYSICS

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