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

APPROVED BY:
Acting Vice-rector for academic affairs,
Omarova D.A.
" 31 " августа 2020 у.

WORKING PROGRAM OF THE DISCIPLINE
« PHYSICS, MATHEMATICS »

Discipline index – Б1. Б. 10

Specialty (direction): 31.05.01 - General medicine

The level of higher education - specialty

Graduate qualification: Physician

Faculty of General medicine

Department - Biophysics, Informatics and medical equipment
Form of training: full-time
Course: 1
Semester: 1
Total labor intensity (in credits / hours): 3/108 hours
Contact – 72 hours
lectures - 24 hours
practical classes - 24 hours
laboratory classes - 24 hours
independent work of the students - 36 hours
form of control: credit

MAKHACHKALA, 2020

The working program of the discipline "Physics, mathematics" was developed on the basis of the curriculum Main Professional Educational Program of Higher Education the specialty (direction) 05. 31.01 General medicine, approved by Academic Council of the University, Protocol №1 f rom August 30, 2018, in accordance with FSES HE №95 on direction of training (speciality) 31.05.01 General medicine approved by the Ministry of education and science of the Russian Federation 09.02.2016 y.

The working program of the academic discipline was approved at the meeting of the Department of Biophysics, Informatics and Medical devices of August 31, 2020, Protocol № 1.

The work program has been agreed with:

1. Director of the SML of DSMU _____ **(V.R. Musayewa)**

2. Head of the Department for Educational Methodical Work of Students and Quality Control of Training _____ **__ (A.M. Karimova)**

3. Dean of the Faculty of Medicine, Doctor of Medical Sciences, Professor _____ **(R.M.Ragimov)**

Compilers:

1. Head of the Department of Biophysics, andidate of Physical and mathematical Sciences, Associate Professor **M.A. Magomedov**

2. Associate Professor of the Department of Biophysics, Candidate of Physical and Mathematical Sciences, Associate Professor **A.M. Kurbanova**

3. Assistant of the Department of Foreign and Latin languages, Candidate of Philology Sciences, Associate Professor **M.A. Magomedova**

The reviewer:

1. Head of the General and Biological Chemistry Department of DSMU, Professor E.R. Nagiyev

2. Head of department of theory and methods of physics teaching of DSPU, Doctor of physical and mathematical Sciences, Professor G.M. Magomedov

CONTENTS

1. THE PURPOSE AND OBJECTIVES OF MASTERING OF THE DISCIPLINE

Purpose: to form at medical students the system knowledge about physical properties and the physical processes proceeding in biological objects, including a human body, necessary both for studying of other educational disciplines, and for direct formation of the doctor.

Tasks:

1. to format of modern natural science ideas about the surrounding material world;
2. to develop in students a methodological focus, essential for solving problems of evidence-based medicine;
3. formation of students: logical thinking, ability to accurately formulate a problem, ability to calculate the main and secondary importance, ability to draw conclusions based on the obtained measurement results;
4. to master of mathematical methods of solving intellectual tasks aimed at preservation of population's health taking into account factors of unfavorable influence of environment.

2. LIST OF PLANNED LEARNING OUTCOMES

Competencies formed in the course of studying the discipline

№	*Name of category (group) of competence*	*A graduate who has completed programme of specialty must have the following competences*
1	**2**	**3**
1.	**General cultural competencies**	**GCC-1 - ability to abstract thinking, analysis, synthesis**
		To know: mathematical methods of intellectual problems solving, basic laws of physics, basic regularities and tendencies development of the world historical process; outstanding scientists-physicists who contributed to medicine. **Be able to:** to describe physical and mathematical laws and theorems, use educational, scientific, popular scientific literature, the Internet for professional activities. **Possess:** skills to analyze and draw appropriate conclusions based on experimental measurements.
		GCC-*5 - readiness for self-development, self-realization, self-education, use of creative potential*
		To know: basic laws of physics, basic patterns and trends of development of the world historical process, basic formulas of differential and integral calculus. **To be able:** to use educational, scientific, popular scientific literature, the Internet for professional activity **To possess:** the ability to use physical and mathematical laws in professional activities.
2.	**General professional competencies**	**GPC -7** – ***readiness to use basic physical-chemical, mathematical and other natural science concepts and methods in solving professional problems***
		To know: safety rules and work in physical laboratories with devices and apparatus; basic laws of physics, physical phenomena and laws underlying the processes occurring in the human body; the physical basis of the functioning of medical equipment, structure and purpose of medical equipment; physical and chemical essence of processes occurring in a living organism at the molecular, cellular, tissue and organ levels. **To be able to:** use physical equipment; predict the direction and result of physical and chemical processes and chemical transformations of biologically important substances. **To possess:** skills of using measuring, computing facilities, basics of safety when working with devices.
3.	**Professional competencies**	**PC-21** – ***capacity to participate in scientific research***

		To know: mathematical methods for solving intellectual problems and their application in medicine. **To be able to:** make calculations based on the results of the experiment, to carry out basic statistical handling of experimental data. **To possess:** skills of using measuring, computing facilities, the basics of safety when working with devices; skills of making a preliminary diagnosis based on the results of laboratory and instrumental examination of patients.

3. PLACE OF THE ACADEMIC DISCIPLINE IN THE STRUCTURE OF EDUCATIONAL PROGRAM

The educational discipline "**Physics, mathematics**" is studied in the first semester and belongs to the basic part of the **Б1** curriculum on specialty **31.05.01 - - General medicine**.

Mastering the discipline "**Physics, Mathematics**" should precede the study of disciplines:

- normal physiology;
- biochemistry;
- microbiology and virology;
- hygiene;
- public health and health care;
- neurology;
- medical genetics;
- ophthalmology;
- propaedeutics of internal diseases;
- radiation diagnostics and therapy;
- forensic medicine of disasters.

The following **knowledge, abilities** and **skills** are needed to study this academic discipline, which are formed during school physics and mathematics courses.

The knowledge: mathematical methods for solving intellectual tasks; basic laws of physics.

The ability: to describe physical and mathematical laws and theorems; to distinguish constants and variables; to distinguish independent and dependent variables; to distinguish types of functions, to carry out identical transformations of mathematical expressions.

The skills: to solve physical and mathematical tasks.

4. LABORIOUSNESS OF THE ACADEMIC DISCIPLINE AND TYPES OF ACADEMIC WORK

Type of academic work		Total hours	Semester
			1
Auditory lessons (total), including:		72	72
Lectures (L)		24	24
Practical lessons (PL)		24	24
Laboratory classes		24	24
Independent work of a student (IWS), including:		36	36
Type of intermediate certification		**credit**	
Total: total labor intensity	**hours**	108	108
	credit	3	3

4.1. Sections of the discipline and interdisciplinary links with subsequent disciplines.

№	Name of disciplines to be provided (subsequent)	№№ numbers of the sections of the discipline, which are necessary for the study of the provided (subsequent) disciplines					
		1	2	3	4	5	6
1	Normal physiology		+	+		+	+
2	Public health and health care, health economics	+			+		+
3	Neurology, medical genetics, neurosurgery	+	+	+	+	+	
4	Otorhinolaryngology		+	+		+	
5	Ophthalmology		+	+	+	+	
6	Propaedeutics of internal diseases, radiation diagnostics	+		+	+		+
7	Oncology, radiation therapy	+		+			+
8	Forensic Medicine	+	+	+		+	+
9	Medical Rehabilitation		+	+	+	+	
10	Life safety, disaster medicine	+	+	+	+		+

5. STRUCTURE AND CONTENT OF THE ACADEMIC DISCIPLINE

5.1. Sections of the academic discipline and competences that to be learned in the study

№	№ of competition	Name of the section of the academic discipline	Section Contents
1	**2**	**3**	**4**
1	***GC-1 GPC-7***	***Elements of Higher Mathematics.***	1. Basic concepts of mathematical analysis. Derivatives and differentials. The rules of integration. Calculations of undefined and defined integrals. Methods for solving first order differential equations with separating variables.
2	***GC-1 GPC-7***	***Physics of liquids, gases, and solids. Acoustics***.	1. The mechanical waves. The Flat Wave Equation. Parameters of oscillations and waves. Energetic characteristics. Wave diffraction and interference. Doppler effect and its use in medicine. 2. Acoustics. Sound. Types of sounds. Complex tone and its acoustic spectrum. Wave resistance. Objective (physical) and subjective (physiological) characteristics of sound. Audiometry. Ultrasound. Physical basics of ultrasound application in medicine. 3. Physical foundations of hemodynamics. Viscosity. Methods for determining the viscosity of liquids (Stokes method, Ostwald method). Stationary flow, laminar and turbulent flow. Newton's formula. Newtonian and non-Newtonian liquids. Poiseuille's Formula. Reynolds number. Hydraulic resistance in series, parallel and combined tube systems. Branching vessels. 4. The mechanical properties of biological tissues. Hooke Law.
3	***GPC-7 PC-21***	***Electricity and Magnetism***	1. Biological cell membranes and their physical properties. Transfer of substances through biological membranes. Fick equation. Nernst-Planck equation. Equilibrium transmembrane potential, Nernst equation. Stationary Goldman-Hodgkin-Katz potential. Resting potential. Action potential. 2. Electric dipole. Current dipole. Electric field of a current dipole in an unlimited conducting medium. The heart is like a current dipole. 3. Physical processes occurring in body tissues under the influence of direct and alternating currents and electromagnetic fields. Total resistance (impedance) in electrical circuits. Ohm law for alternating current and voltage.

			The capacitive and ohmic resistance of biological tissues in the body.
4	***GPC-7 PC-21***	***Basics of Medical Electronics***	1. Basic notions of medical electronics. Safety and reliability of medical equipment. Features of signals processed by medical electronic equipment and related requirements for medical electronics. Principle of operation of medical electronic equipment (generators, amplifiers, sensors).
5	***GPC-7***	***Optics***	1. Geometric optics. The phenomenon of total internal reflection of light. Refractometry. Fiber optics. The eye is an optical system. Microscopy. 2. Wave optics. Electromagnetic waves. Scale of electromagnetic waves. Energy characteristics of light flows: the flow of light radiation and the density of the flow (intensity). Diffraction grating. Resolving power of optical instruments and the eye. Light polarization. Polarizing microscopy. Optical activity. Polarimetry. 3. Interaction of light with substance. Scattering of light. Absorption of light. Booger-Lambert-Ber Law. Optical density. 4. Thermal radiation. Characteristics and laws of thermal radiation. The spectrum of black body radiation. Radiation of the Sun.
6	***GPC-7 PC-21***	***Quantum physics, ionizing radiation***	1. Quantum physics. Scheme of electronic energy levels of atoms and molecules and transitions between them. Spectrophotometry. Luminescence. Stokes Law for Photoluminescence. Spectra of luminescence. Spectrofluorimetry. Luminescent microscopy. 2. Lasers. Features of laser radiation. 3. X-ray radiation. Interaction of X-ray radiation with substance. Law of X-ray radiation attenuation. 4. Radioactivity. The law of radioactive decay. Interaction of α-, β- and γ-radiation with substance. Mechanism of action of ionizing radiation on human organism. 5. Dosimetry of ionizing radiation. Absorbed, exposition and equivalent doses.

№	Controlled sections (topics), modules of the discipline	Amount of test tasks (total)	Controlled competencies (or parts of them)		Situational tasks (total)
1	Elements of Higher Mathematics	127	GC-1 GPC-7	41, 86	48
2	Physics of liquids, gases and solids. Acoustics	142	GC-1 GPC-7	54, 88	18
3	Electricity and magnetism	84	GPC-7 PC-21	30, 54	33
4	Basics of Medical Electronics	29	GPC-7 PC-21	11 18	15
5	Optics.	74	GPC-7	74	45
6	Quantum physics, ionizing radiation.	72	GPC-7 PC-21	25, 47	25

5.2 Sections of the discipline, types of educational activities and forms of current monitoring of progress and intermediate certification based on the results of the discipline

№	*Semester*	*Name of the discipline section*	*Types of activity (in hours)*					*Assessment tools for the current control of academic performance and intermediate certification based on the results of mastering the discipline*
			Lectures	*Practical*	*Laboratory*	*Independent*	*Total*	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	**1**	Elements of Higher Mathematics	4	8	-	4	16	I, CW, TC, A, PS
2	**1**	Physics of liquids, gases and solids. Acoustics	11	6	7	8	32	I, CW, TC, A, PS
3	**1**	Electricity and magnetism	2	4	9	8	23	I, CW, TC, A, PS
4	**1**	Basics of Medical Electronics	2	-	-	4	6	A
5	**1**	Optics	2	2	6	6	16	CW, TC, A, PS
6	**1**	Quantum physics, ionizing radiation	3	4	2	6	15	I, CW, TC, A, PS
7	**1**	Type of intermediate certification	**Credit**					***Ticket Interview***
Total:			24	24	24	36	108	

The following abbreviations are used: I - interview; CW - control work; TC - test control; A - abstracts; PS - practical skills.

5.3. Name of lecture topics and amount of hours of academic discipline

№	Name of lecture topics of academic discipline	Amount of hours
1	Notion of a function and of an argument. Functional dependence. Differential and integral calculus. Differential equations. Methods of solving first-order differential equations with separable variables.	2
2	The method of modeling. Basic principles of scientific modelling. Models of studying population size. Model of pharmacokinetics.	2
3	Physical methods as an objective method of studying regularities in the living nature. The importance of physics for medicine. Mechanical oscillations and waves. Types of oscillations. Parameters of oscillations and waves. The complex oscillations. Fourier's Theorem. Wave equation of a plane wave. Sound, ultrasound. The parameters of the ultrasound. Physical processes in tissues when exposed to ultrasound. Ultrasound in medicine.	3
4	Viscosity. Methods of determining the viscosity of liquids. Laminar and turbulent flow. Newton's formula. Newtonian and non-Newtonian fluids. The Poiseuille's formula. Reynolds number. Hydraulic resistance. Branching vessels. Distribution of hydraulic resistance, blood flow rate, pressure along the circulatory system.	2
5	Cardiovascular system. Pulse wave. Model of blood flow in a large vessel. The structure of the muscles. Biomechanics of muscles. Hill's Equation. Electromechanical conjugation in the muscles.	2
6	Self-oscillations in organs and tissues. Auto waves in homogeneous tissues. Transformation of rhythm. Reverberators. Electric fields in the organs. Physical principles of electrocardiography. Study of electrical activity of the brain.	2
7	Electromagnetic waves. Scale of electromagnetic waves. Properties of electromagnetic waves. Equation and graph of the plane electromagnetic running wave. Energy characteristics. Telemedicine.	2
8	Natural and artificial sources of electromagnetic radiation. Modern computer tomography. Interaction of electromagnetic (including X-ray) radiation with the human body.	2
9	Types of human own physical fields and their sources. Low-frequency electric and magnetic fields. Infrared radiation. Thermography. Electromagnetic optical radiation.	2
10	The quantum nature of light. Spectrophotometry. Luminescence. Varieties of luminescence. The Stoke's Law. Spectroluminescence. Spectrofluorimetry. Luminescent microscopy.	2
11	Ionizing radiation dosimetry. Absorbed, exposure and equivalent doses. Radiation background. Methods of protection against ionizing radiation. Maximum allowable dose of ionizing radiation. Radiation safety factors.	3
TOTAL		24

5.4. Names of practical and laboratory classes with amount of hours

№	*Topics of classes*	*Amount of hours (semester I)*	
		Practical classes	***Laboratory classes***
1	Elements of Higher Mathematics: Differential Calculation	2	
2	Elements of Higher Mathematics: Integral Calculation	2	
3	Differential equations. Differential equations of the first order with separating variables.	2	
4	Models of biological kinetics and pharmacokinetics.	2	
5	Sonic, ultrasonic waves. Wave parameters. Physical processes in tissues under the influence of ultrasound. Physical basics of ultrasound - diagnostics and therapy.	2	
6	Basics of hemodynamics.	2	
7	Electrical activity of cells. Membrane electrical potentials.	2	
8	Biophysics of muscle contraction.	2	
9	Optical system of the eye.	2	
10	Biophysical basis of action of ionizing radiation on body tissues and application of radionuclides in medicine.	3	
11	Physical basics of the computer projection tomographical X-rays diagnostics. Evaluation of the contrast of the X-ray image.	3	
12	Detection of spectral characteristics of ear threshold.		2
13	Study of mechanical properties of the tissues of the organism on the model materials (metals, polymers). Measurement of coefficient elasticity and hardness		2
14	Determination of fluid viscosity by the Stokes method and with a medical viscometer.		3
15	Physical foundations of galvanization. Study of the device and principle of operation of the apparatus of the galvanization at the model electrical scheme.		2
16	Physical basics of UHF therapy. The device and principle of operation of the UHF therapy.		2
17	Electrical properties of tissues. Determination of the dispersion of the electrical conductivity on the modeled electrical schemes for living tissue.		3
18	Physical bases of the ECG		2
19	The interaction of light with matter. Absorption of light. Photoelectric calorimetry.		2
20	Interaction of light with substance. Scattering, polarization of light. Refractometry. Polarimetry.		2
21	Laser. Study of laser radiation wavelength and erythrocyte dimensions.		2
22	Radioactivity. Dosimetry.		2
	Total	**24**	**24**

5.5. Self-study work of student of the discipline

№	*Controlled competences*	*Name of discipline section (module)*	*Types of self-study work of students*	*Total hours*
1	**2**	**3**	**4**	**5**
I semester				
1	GC-1, PC-7	**Section 1**	Study of educational and scientific literature Preparing for a practical lesson Working with lecture material Preparing for the test.	4
2	GC-1, GPC-, PC-7, PC-21	**Section 2**	Study of educational and scientific literature Preparing for a practical lesson Preparing for a lab session Working with lecture material Preparing for the test.	8
3	GC-1, GPC-6, PC-5	**Section 3**	Study of educational and scientific literature Preparing for a practical lesson Working with lecture material Preparing for the test.	8
4	GC-1, GPC-6, PC-5, PC-12	**Section 4**	Study of educational and scientific literature Working with lecture material, preparing of an abstract	4
5	GC-1, GPC-6, PC-5, PC-12	**Section 5**	Study of educational and scientific literature Preparing for a practical lesson Working with lecture material Preparing for the test. Solving tasks assigned on Practical classes	6
6	GC-1, GPC-6, PC-5, PC-12	**Section 6**	Study of educational and scientific literature Preparing for a practical lesson Working with lecture material, preparing an abstract	6
TOTAL in the semester:				**36**

Topics of abstracts for self-study work of students

№	*Section*	*Topics of abstracts*
1	1	Mathematical modeling of pharmacokinetic processes.
2	2	Physical bases of acoustic research methods in medicine audiometry, percussion, auscultation, phonocardiography.
3	3	Electric dipole. Current dipole.
4	4	Electromagnetic wave. Scale of electromagnetic waves.
5	5	Nuclear magnetic resonance (NMR) and its biomedical applications.
6	6	Physical principles of positron emission tomography (PET). Application of PET methods in medicine.

6. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

6.1. Main literature

Printed sources:

№	*Name*	*Author(s)*	*The year, the place of publication*	*Amount of copies*	
				At the library	*In the department*
1	Practical course on physics and mathematics	Kurbanova A.M., Truzhenikova S.E.	Makhachkala, Publishing and printing center of the DSMU, 2017.	70	30

6.2. Additional literature

Printed sources:

№	*Name*	*Author(s)*	*The year, the place of publication*	*Amount of hours*	
				At the library	*In the department*
1	Columbia Review. Yigh-Yeld Physics	Stephen D.Bresnick	Williams & Wilkins, San Francisco, California, 1996.		1

LIST OF INTERNET INFORMATION AND TELECOMMUNICATION NETWORK RESOURCES

№	*Name of a resource*	*Website address*
1.	PubMed MEDLINE	http://www.pubmed.com
2.	Google scholar	http://scholar.google.com
3.	Scirus	http://www.scirus.com/srapp
4.	Health Issues. WHO information	http://www.who.int/en/
5.	Electronic Science Library	https://elibrary.ru/defaultx.asp
6.	Univadis®: an international information and educational portal that helps doctors around the world to stay at the forefront in their specialties.	http://www.medlinks.ru/
7.	Medical search engine	http://www.medinfo.ru/
8.	Faculty of Fundamental Medicine of Moscow State University named after M. V. Lomonosov (publications).	http://www.fbm.msu.ru/sci/publications/
9.	Reference book of drugs.	http://www.rlnet.ru/
10.	Electronic library Russian Federal Property Fund.	http://www.rfbr.ru/
11.	State Central Scientific Medical Library.	http://www.scsml.ru//
12.	Libraries in the Internet.	http://guide.aonb.ru/libraries1.htm
13.	Science and education on the Internet.	http://guide.aonb.ru/nauka.htm
14.	Electronic library of textbooks.	http://studentam.net

7. EDUCATIONAL TECHNOLOGIES

When studying the discipline, a common set of documents and Internet materials is used, which provide wide opportunities for improving University training in physics and mathematics in order to master the skills of educational activities. The standard features of most programs are the implementation of the didactic principle of visualization in teaching, their use allows students to apply various methods for solving educational problems.

Work with educational literature is considered as a type of educational work in the discipline "Physics, mathematics" and is performed within the hours allotted for its study (in the section of the IWS).

Each student is provided with access to the library collections of the University and the Department. Methodological recommendations for students have been developed for each section of the discipline.

Methods of teaching using information technologies, used both in lectures and in practical classes in physics and mathematics, include:

- computer testing;
- demonstration of multimedia materials;
- list of encyclopedic sites.

8. MATERIAL AND TECHNICAL SUPPORT

Information about the material and technical support necessary for the implementation of educational process in the discipline

№	Address (location) of building, structures, premises	Ownership or operational management, economic management, lease, sublease, gratuitous use	Name of discipline	Purpose of equipped buildings, structures, premises, territories with an indication of the area (sq. m.)	Name of special rooms and rooms for independent work	Equipment of special rooms and rooms for independent work	The list of licensed software. Details of the supporting document
	44 Shamil Street, 3rd floor of a five-story building.	Operational management	Physics, mathematics.	For the educational and scientific educational process	For lectures classes-halls #1, # 2 and #3 For practical classes-audience №1, №2, №3, №6 and #7 Staff room	For lectures: set of electronic presentations/slides. Samsung Laptop; Epson EB-X02 projector; Canon MF 231; personal computer For practical and laboratory classes – a set of demonstration tables and posters; oscilloscope; laser; sound generator; ULTRASONIC generator; polarimeter; optical microscope; UHF therapy device; photoelectrocolorimeter; Refractometer; dosimeter; installation for determining the hardness of dental materials; computer classes with an installed program for testing KTS.	The list of software (Win HOME 10 Russian OLP (Sublicense agreement dated 12/08/15); KASPERSKY Edition Security for Business - Standard Russian Edition. 100-149 Node contract No. 1081-2015 dated 10/14/13, etc. .

9. STAFFING

Information about personnel support required for the implementation of educational process in the discipline
The total amount of research and teaching staff implementing the discipline is 14 people.
The total amount of rates occupied by research and teaching staff implementing the discipline is 12.5 rates.

	Full name of the teacher	Terms of engagement (full-time, internal part-time, external part-time under the contract)	Current position held, academic degree / academic title	List of subjects taught according to the curriculum	Education (which educational institution of professional education graduated from, year)	The level of education, the name of the specialty on the diploma, the name of the assigned qualification	The amount of academic load for the discipline (the percentage of the rate)	Information about additional professional education		Total experi-ence
								On speciality	In pedagogy and psychology	
1	Magomedov Magomed Abakarovich	St.	Head of the Department, Candidate of physical and mathematical Sciences, associate Professor	Physics, mathematics; biomedical statistics, medical equipment	DSU, 1969	Specialist, physicist	1 state unit	2013		
2	Rizakhanov Magomed Ahmedpashaevich	St.	Doctor of physical and mathematical Sciences, Professor	Physics, mathematics; biomedical statistics, medical Informatics	DSU, 1962	Specialist, physicist	1 rate		2016	
3	Mutalipov Magomed Malamagomedovich	St.	Associate Professor, candidate of physical and mathematical Sciences	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics	DSU, 1959	Specialist, physicist	1 state unit	2016		

4	Magomedov Magomed Musayevich	St.	Associate Professor, candidate of physical and mathematical Sciences	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics	DSU, 1966	Specialist, physicist	1 state unit			
5	Khurshilova Zarema Arslanbekovna	St.	Associate Professor, candidate of physical and mathematical Sciences	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics	MSU, 1973	Specialist, biophysicist	1 state unit			
6	Magomedov Magomed-Rasul Magomedovich	St.	Associate Professor / Associate Professor	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics, Hardware treatment methods in dentistry	DSU, 1970	Specialist, physicist	1 state unit			
7	Abdulgalimov Ramazan Medzhidovich	St.	Head of the Educational part of the Department, Associate Professor, candidate of pedagogics	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics, Hardware treatment methods in dentistry	DSPI, 1984	Specialist, physicist mathematician	1 state unit	2013	2018	
8	Kurbanova Anzhella Magomedovna	St.	Associate Professor, candidate of physical and mathematical Sciences	Physics, mathematics; medical and biological statistics, medical Informatics	DSU, 1986	Specialist, physicist	1 state unit			

9	Atluhanova Louise Bremovna	St.	Associate Professor, candidate of pedagogics/ Associate Professor	Physics, mathematics; medical and biological statistics, medical Informatics	DSPU, 2001	Magistracy, physicist	1 state unit		2016	
10	Truzhenikova Svetlana Egorovna	St.	Senior lecturer	Physics, mathematics; medical and biological statistics, medical Informatics	DSPI, 1985	Specialist, engineer-designer technologist of REE	1 state unit			
11	Kasimov Arif Kamalutdinovich	External part-time user	assistant, candidate of pedagogics	Physics, mathematics; medical and biological statistics, medical equipment, medical Informatics	DSPI	Specialist, physicist mathematician	1 state unit		2016	
12	Guseynov Marat Kerimkhanovich	External part-time user	assistant, candidate of physical and mathematical Sciences	Physics, mathematics; medical and biological statistics, medical equipment	DSU	Specialist, physicist	0,5 state unit			

10. LIST OF CHANGES TO THE WORKING PROGRAM

Changes to the work program are made on the basis of orders and orders of the rector, as well as on the basis of decisions on improving the educational and methodological support of the discipline, approved at the appropriate level (decision of the Academic Council), CCMS and registered in the list of changes.

Sheet for registering changes to the working program

Academic year	***Date and number of notification of changes***	***Protocol Details***	***Section, division***	***Signature, registering the changes***
2019-2020				
2020-2021				
2021-2022				

FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION
HIGHER EDUCATION INSTITUTION
DAGESTAN STATE MEDICAL UNIVERSITY
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION

Department of Biophysics, Informatics and medical equipment

APPROVED:
at the meeting of the Department
"_31_" August 2020
Protocol № _1_
Head of the Department
Associate Professor Magomedov M.A.

ASSESSMENT MEANS FUND
OF EDUCATIONAL DISCIPLINE
"PHYSICS MATHEMATICS"

Specialty (direction) of preparation: 31.05.01 - General medicine

Qualification of the graduate: Physician

MAKHACHKALA – 2020

AMF are composed by:
Magomedov M.A., Kurbanova A.M.
AMF reviewed and adopted at a meeting of the Department of Biophysics, Computer Science and Medical Equipment

Protocol of the meeting of the department № 1 of August 31, 2020

Head of the Department _____ (Magomedov M.A.)

ACTUALLY on:

2020/2021 academic year _____
20__ /20__ academic year _____
20__ /20__ academic year _____

MAP OF STUDENT COMPETENCIES
FORMED AS A RESULT OF MASTERING OF THE DISCIPLINE
"PHYSICS, MATHEMATICS"
Competencies formed in process of studying the discipline

№	*Name of the category (group) of competencies*	*A graduate who has mastered the specialty program must have the following competencies*
1	**2**	**3**
1	**General cultural competencies**	**GCC-1 - the ability to abstract thinking, analysis, synthesis**
		Know: mathematical methods for solving intellectual problems, the basic laws of physics, the basic consistent patterns and trends of the development of the world historical process; prominent physicists who have contributed to medicine. **Be able to**: state physical and mathematical laws and theorems, use educational, scientific, popular scientific literature, the Internet for professional activities **Skills**: to analyze and draw appropriate conclusions based on experimental measurements**.**
		GCC-5- ***readiness for self-development, self-realization, self-education, the use of creative potential***
		Know: the basic laws of physics, the basic laws and trends of the development of the world historical process, the basic formulas of differential and integral calculus. **Be able to:** use educational, scientific, popular science literature, the Internet for professional activities **Skills:** the ability to use physical and mathematical laws in professional activities
2	**General professional competencies**	**GPC -7 - readiness to use the basic physical, chemical, mathematical and other natural science concepts and methods in solving professional problems**
		Know: safety regulations and work in physical laboratories with instruments and apparatus; basic laws of physics, physical phenomena and consistent patterns that underlie the processes taking place in the human body; physical foundations of the functioning of medical equipment, device and purpose of medical equipment; physicochemical nature of the processes occurring in a living organism at the molecular, cellular, tissue and organ levels **Be able to:** use physical equipment; to predict the direction and result of physicochemical processes and chemical transformations of biologically important substances. **Skills:** skills in using measuring, computing tools, the basics of safety when working with devices.

3	**Professional Competencies**	**PC-21 - ability to participate in research**
		Know: mathematical methods for solving intellectual problems and their application in medicine **Be able to:** make calculations based on the results of the experiment, conduct elementary statistical processing of experimental data **Skills:** skills in using measuring, computing tools, the basics of safety when working with devices; preliminary diagnosis skills based on the results of laboratory and instrumental examination of patients

LEVEL OF ACQUISITION OF COMPETENCES IN THE DISCIPLINE "PHYSICS, MATHEMATICS»

Competencies not mastered	***Based on the results of control measures, a result of less than 50% was obtained***	***Answers to the main questions of the discipline were not received***
Basic level	According to the results of control measures, the result is 50-69%	Answers to questions and solutions to tasks are not complete enough. Logic and consistency in solving problems have violations. There are no conclusions in the responses.
Average level	According to the results of control measures, the result is 70-84%	Complete answers to the questions are given. The ability to identify cause-and-effect relationships is shown. When solving problems, minor errors were made, corrected with the help of "leading" questions from the teacher.
Advanced level	According to the results of control measures, the result is higher than 85%.	The answers to these questions are complete, clear, and detailed. Problem solutions are logical, evidence-based, and demonstrate the student's analytical and creative abilities.

APPRAISAL TOOLS FOR MONITORING PROGRESS AND INTERMEDIATE CERTIFICATION BASED ON THE RESULTS OF MASTERING THE DISCIPLINE

Competencies formed in the course of studying the discipline

a. Tests in accordance with the competencies for current control

Competence code	Evaluation material
GCC-1, GCC-5 GPC-7	**1.** Doppler effect … a. change in the intensity of the wave perceived by the wave receiver (observer), due to the relative movement of the wave source and the observer. b. change in the amplitude of the wave perceived by the wave receiver (observer), due to the relative movement of the wave source and the observer. c. change in the frequency of the wave perceived by the wave receiver (observer), due to the relative movement of the wave source and the observer. d. change in the phase of the wave perceived by the wave receiver (observer), due to the relative movement of the wave source and the observer. **2.** Ultrasound is… a. mechanical (elastic) wave with a frequency from $2 \cdot 10^4$ to 10^9 Hz. b. mechanical (elastic) wave with a frequency from 20 to 20000 Hz. c. mechanical (elastic) wave with a frequency less than 20 Hz. d. mechanical (elastic) wave with a frequency more than 10^9 Hz. **3.** The oscillation amplitude is: a. amount of vibrations per second. b. maximum displacement of the oscillating body from the equilibrium position. c. time of one oscillation of the body. d. value that determines the position of the oscillating point at a given time and the direction of its movement. **4.** The oscillation period is: a. amount of complete oscillations made in one second; b. value that determines the position and direction of motion of the oscillating body; c. maximum displacement of the oscillating body from the equilibrium position; d. time of one complete oscillation. **5.** Oscillation frequency is: a. amount of oscillations in one period; b. maximum displacement of the oscillating body from the equilibrium position; c. time of one complete oscillation; d. amount of complete oscillations made in one second. **6.** A mechanical wave is a mechanical disturbance: a. localized in space; b. propagating in an elastic medium and carrying energy; c. self-excited in space; d. propagation is not related to energy transfer. **7**. Energy characteristic of sound - a. timbre; b. height; c. intensity; d. frequency. **8.** The determination of the threshold of audibility - a. the lowest frequency of sounds at which subtle auditory sensations occur; b. the lowest sound intensity at which a subtle auditory sensation occurs;

	c. the highest sound intensity at which auditory perception of sound ceases; d. the highest frequency of sound at which a subtle auditory sensation occurs. **9.** Subjective sound characteristics: a. intensity; b. height; c. sound pressure; d. sound intensity level. **10.** Select the objective characteristic of the sound: a. height; b. volume; c. frequency; d. timbre. **11**. Select the subjective characteristic of the sound: a. intensity; b. sound pressure; c. frequency; d. timbre. **12**. Indicate the item where the subjective characteristic of the sound is named: a. frequency; b. intensity; c. sound pressure; d. volume. **13.** Objective sound characteristics: a. height; b. noise; c. intensity; d. timbre. **14.** Indicate the item where the objective characteristic of the sound is named: a. tone; b. volume; c. height; d. acoustic spectrum. **15.** A phonocardiograph is a device for: a. measuring the audibility threshold; b. measuring the level of audibility; c. recording sounds that accompany the heart; d. measurement of electrical signals of the heart. **16**. Background: a. unit of measurement of the sound intensity level; b. unit of the scale of sound volume levels. c. unit of measurement of the sound intensity scale; d. unit of measurement of the sound pressure scale. **17.** An objective sound parameter that determines the sound's timbre. a. frequency; b. intensity; c. pressure; d. acoustic spectrum. **18**. What curves are used to determine the correspondence between the volume and intensity of sound at different frequencies? a. on curves of equal frequency; b. on curves of equal intensity; c. by equal volume curves; d. using equal sound pressure curves. **19**. Basic diagnostic methods based on the use of ultrasound: a. ultrasonic transmission methods, ultrasonic absorption methods b. ultrasonic methods of thermal effect, massage c. ultrasonic methods of macromolecule destruction, ultrasonic methods of tissue dissection d. ultrasonic location methods, ultrasonic Doppler methods. **20**. Physical processes observed when ultrasound affects the body's tissues: a. membrane rearrangement, destruction of cells, macromolecules, changes in membrane permeability; b. change in blood flow rate; c. changes in blood pressure; d. changes in surface tension and aggregate state of membrane structures, etc. **21.** Which parameter of the medium mainly forms the features of the distribution of ultrasound in the medium? a. acoustic impedance (wave resistance); b. acoustic spectrum (harmonic spectrum); c. the index is refracted;

	d. specific thermal capacity. **22**. what vibrational systems are the heart and lungs? a. free; b. forced; c. self-oscillating; d. harmonic. **23**. What type of oscillation are self-oscillations? a. free; b. forced; c. damped; d. undamped. **24**. Component of the self-oscillating system: a. amplifier; b. energy source; c. generator; d. rectifier. **25**. Select the device as part of the self-oscillating system: a. resistance; b. generator; c. amplifier; d. oscillating body. **26**. Which of the following elements is an integral part of the self-oscillating system? a. amplifier; b. generator; c. regulator; d. rectifier. **27**. The mechanism without which self-oscillation does not occur: a. amplification of vibrations; b. heating the self-oscillating system; c. feedback; d. resonance.
PC-21	**28**. The main medical and biological direction of ultrasound application: a. diagnosis of diseases; b. strengthening of biochemical processes; c. destruction of pathological cells; d. increased electrical activity of the membranes. **29**. Physical basis of the method of ultrasonic location of organs for the purpose of diagnostics. a. obtaining images of tissues by using diffraction of ultrasonic waves when they are propagated through internal organs b. obtaining images of tissues by registering ultrasound rays that have passed through the tissues c. obtaining images of tissues by using the phenomenon of absorption of ultrasonic waves by body tissues d. obtaining an image of tissues by registering the reflected ultrasonic signal from the borders of tissues with different acoustic resistances. **30**. The ultrasonic echodopler method is a method for determining the speed of mobile tissues in the body (blood, valves, and heart walls) by measuring: a. intensity of ultrasonic waves passing through tissues; b. the intensity of ultrasonic waves reflected from the borders of tissues with different acoustic resistances; c. changes in the frequency of ultrasound observed when it is reflected from tissues; d. the coefficient of absorption of ultrasound by body tissues. **31**. Primary mechanism of ultrasound therapy: a. activation of transport of substances through membranes; b. mechanical and thermal; c. destruction of pathological cells; d. increased electrical activity of macromolecules. **32**. Behavior of ultrasonic rays when they fall on the interface of media with different wave (acoustic) resistance: a. completely absorbed; b. completely dissipate; c. partially reflected and partially refracted; d. diffracted. **33**. The phenomenon used in surgery and observed when high-intensity ultrasound is applied to solid bodies: a. evaporation; b. crystallization; c. melting; d. destruction.

	34. What impulses are recorded for diagnostic purposes in ultrasound locations? a. passed through fabrics with different acoustic properties; b. scattered at the interface of two media with different acoustic properties; c. reflected from the interface of two media with different acoustic parameters; d. interfered at the interface of two media with different acoustic parameters. **35**. The biological effect of ultrasound on the body is based on…: a. mechanical, thermal and chemical action of ultrasound; b. electrical, optical action of ultrasound; c. acoustic, magnetic action of ultrasound; d. nuclear action of ultrasound. **36**. The therapeutic effect of ultrasound is one-factor or complex: a. one-factor, namely mechanical; b. one-factor, namely magnetic; c. one-factor, namely chemical; d. complex: mechanical plus physical and chemical. **37**. Classification of sounds: a. cavitation, shock waves; b. tones, noises, sound waves; c. vibration, resonant sounds; d. forced, fading, harmonic sounds. **38**. Processes observed when ultrasound is applied to the body's tissue: a. increase in surface tension of membranes; b. membrane transition from one phase to another; c. destruction of biomacromolecules; d. change in membrane thermal capacity.
PC-21	**39**. Membrane ion pumps use ...? a. the energy of hydrolysis of ADP molecules; b. the energy of hydrolysis of ATP molecules; c. the energy of the membrane electric field; d. thermal energy. **40**. One of the main features of a living organism: a. fully electrified; b. in thermodynamic equilibrium; c. is a closed system; d. stabilized in all respects. **41**. On what nature of signals (impulses) is the transfer of information in the body from the brain to the peripheral organs and in the opposite direction? a. thermal; b. mechanical; c. electrical; d. chemical. **42**. The functional dependency can be set: a. analytically; b. in the form of a table; c. graphically; d. all listed. **43**. A variable ***Y*** is called a function of another variable ***X***, called an argument, if: a. one argument value corresponds to one function value; b. one argument value corresponds to several values of the function; c. several argument values correspond to one value of the function; d. several values of the argument correspond to several values of the function. **44**. The differential of the function du is equal to: a. the derivative of a function on its argument; b. the derivative of the function multiplied by the differential of the argument; c. a primitive function on its argument; d. the primitive function multiplied by the increments of its argument.

45. Select the type of mechanical deformation of the body:
a. reduced volume during cooling;
b. length increase when heated;
c. shift;
d. length reduction during cooling.
46. Name the type of mechanical deformation of the body:
a. expansion when heated;
b. compression during cooling;
c. volume growth when heated;
d. torsion.
47. Basic mechanical properties of viscoelastic bodies:
a. high hardness, high Young's modulus;
b. combination of elasticity and plasticity;
c. combination of high strength and plasticity;
d. combination of viscous flow and elasticity.
48. What kind of deformation is called elastic?
a. deformation that disappears after the external force ceases;
b. deformation, after which the system does not return to its original state;
c. deformation in which a body flows under the action of a deforming force;
d. the deformation that persists after the external force is removed.
49. Plastic deformation is ...
a. deformation, in which the deformable body returns to its original state after removing the deforming force;
b. deformation in which the body is destroyed;
c. deformation that persists even after the external force ceases;
d. deformation, during which the body flows under the action of a deforming force.
50. Materials that make up the bone tissue is ...
a. inorganic material $3Mg\ (PO_4)Mg(OH)_2$, phospholipid molecules;
b. proteins with β-structure, compounds with Mg and Mn;
c. compounds consisting of elements Na, K, hydroxyl group OH and characterized by high elasticity;
d. inorganic material hydroxylapatite $3Ca_3\ (RO_4)_2Ca\ (OH)_2$, collagen-a protein with high elasticity.
51. Basic mechanical properties of bones are ...
a. high elasticity, low value of Young's modulus;
b. small value of the Young's modulus, small value of the elastic limit;
c. plasticity;
d. hardness, elasticity, strength.
52. Basic mechanical properties of the skin and blood vessels -
a. low elasticity; b. viscoelasticity, high elasticity;
c. great value of Young's modulus; d. high strength, elasticity.
53. Basis of membrane structure -
a. monolayer of phospholipid molecules;
b. liposomes;
c. double layer of lipid molecules;
d. double layer of phospholipid molecules.
54. Structure of membrane phospholipid molecules. Phospholipid molecules consist of functionally different parts:
a. the polar hydrophilic "head" and nonpolar hydrophobic tails;
b. non-polar hydrophobic "head" and hydrophilic polar tails;
c. non-polar hydrophilic "head" and a non-polar hydrophobic tails;

	d. hydrophobic polar "head" and a polar hydrophilic tails. **55**. Which membrane model is generally accepted? a. single-layer membrane model; b. sandwich model; c. liquid-mosaic model; d. liquid model. **56**. What is the flip-flop diffusion? a. diffusion of phospholipid molecules across the membrane; b. diffusion of phospholipid molecules in the membrane plane; c. light diffusion with a fixed carrier; d. light diffusion with a mobile carrier. **57**. What is lateral diffusion? a. diffusion of phospholipid molecules across the membrane; b. lightweight diffusion with a mobile carrier; c. light diffusion with a fixed carrier; d. diffusion of phospholipid and protein molecules in the membrane plane. **58**. Transport phenomena are … a. convection, doping, melting and crystallization; b. only diffusion and viscosity; c. electrical conductivity, thermal conductivity, diffusion, viscosity; d. only electrical and thermal conductivity. **59**. Active transport of ions across membranes is the transfer … a. electrically charged particles from the region with a large con-centration to an area with lower concentration; b. ions without the cost of internal energy; c. charged particles (ions) in an electric field; d. particles from areas with lesser concentration to an area with greater con-centration at the expense of ATP energy. **60**. Determination of ion pumps in biological membranes - a. chloroplast systems; b. systems of phospholipid molecules; c. membrane protein systems; d. cytoplasmic membrane systems. **61**. Types of passive transport of ions and molecules through the mem-brane... a. diffusion through the pores; b. diffusion with movable carriers; c. all of the above; d. diffusion with fixed carriers. **62**. Passive transport of ions and molecules through the membrane - a. transport of molecules and ions in the direction where their concentration falls; b. transfer of ions and molecules through membranes with the expenditure of external energy; c. transport of ions and molecules in the direction where their concentration increases; d. transfer of ions and molecules without changing the gradient of their concentration.
PC-21	**63**. Systolic pressure of a healthy person: a. much higher than 120 mm Hg; b. 120 mm Hg; c. much lower than 120 mm Hg; d. 100 mm Hg. **64**. Method for determining the speed of blood flow, which is widely used in medicine: a. inductothermy method (based on magnetic field measurement); b. ultrasonic method based on Doppler effect; c. electromagnetic method based on Hall effect; d. diathermy method based on the effect of high frequency currents. **65**. The initial pressure required to move blood through the blood vessels is directly created …

	a. heart work; b. energy of ATP molecules; c. kinetic energy of the liquid; d. potential energy of deformed vessels. **66**. What should be done to reduce bleeding from the affected vessel of the extremities? a. give the limbs an elevated position; b. give the limbs a horizontal position; c. keep the limb in a vertical (natural) position; d. bend the limb at the knee.
GPC-7	**67**. Ultrasonic location device is a device a. performing ultrasonic visualization of the research object; b. ultrasound receiver; c. ultrasound generator; d. ultrasound amplifier. **68**. The main purpose of the ultrasound therapy device. a. generation of ultrasound of a certain frequency in continuous and pulsed modes; b. amplification of ultrasound of a certain frequency in continuous and pulsed modes; c. transmission of ultrasound of a certain frequency in continuous and pulse modes; d. receiving ultrasound of a certain frequency in continuous and pulse modes. **69**. What are medical electronic devices based on the principle of operation? a. rectifiers; b. generators; c. amplifiers; d. adders. **70**. The main and most important requirement for ensuring safety when working with electronic equipment. a. make it impossible for patients and staff to touch the parts of devices and devices that are under voltage; b. grounding, zeroing of devices and apparatuses; c. remote activation of devices and devices; d. low power supply voltage. **71**. Basic rules for ensuring safety when working with electrical equipment. a. do not touch the devices simultaneously with two naked hands; b. do not work on a wet floor; c. do not touch metal structures (for example, radiators) when working with electrical equipment; do not touch metal parts of two devices simultaneously; d. all listed. **72**. Electrodes in medical measurements are used for … a. taking of bioelectric potentials and measurement electrical conductivity of fabrics; b. measurement of non-electrical parameters of body tissues; c. converting non-electrical (mechanical, thermal, optical, etc.) information into electrical information; d. amplification of electrical signals. **73**. What are the electrodes? a. dielectrics of various shapes; b. metal components in electronic equipment; c. the conductors of the special form; d. complex technical devices of special design. **74**. Basic requirements for electrodes: a. quickly fixed and removed; b. have stable electrical parameters; c. do not irritate biological tissue; d. all of these reasons. **75**. Classification of sensors according to the principle of action. a. cardiovascular sensors;

	b. sensors-amplifiers of medical and biological information; c. respiratory system sensors; d. generator and parametric.
GPC-7	**76**. Determination of the viscosity coefficient - a. the friction force acting between layers of liquid with an area of 1 m^2 and at a speed gradient $dV/dx=1/ s^{-1}$; b. the force acting between two liquid particles under laminar flow conditions; c. the amount of mechanical stress per 1 m^2 of the liquid cross-section; d. the friction force acting between the liquid layers at a velocity gradient $dV/dx=1/ s^{-1}$. **77**. The Newtonian liquids are .... a. liquids that obey the law $\tau=\tau_0+\eta j$; b. liquids that do not have a viscosity; c. liquids for which the viscosity depends only on their nature and temperature; d. liquids whose viscosity depends on the conditions of their flow, the speed gradient of the liquid. **78**. The non-Newtonian liquids are ... a. liquids whose viscosity depends not only on the nature and temperature, but also on the velocity gradient; b. liquids whose viscosity does not change when the velocity gradient changes; c. liquids whose viscosity does not depend on their flow conditions; d. liquids that do not have a viscosity. **79**. What type of fluids does blood belong to… a. homogeneous; b. Newtonian; c. non-Newtonian; d. for liquids with a very low viscosity coefficient.
PC-21	**80**. What is audiometry? a. method for determining hearing acuity; b. method for determining the threshold of pain; c. method for determining the intensity of sounds; d. acoustic spectrum measurement method. **81**. The definition of audiogram. a. curve of pain threshold versus frequency of sound vibrations; b. curve of the intensity of sounds on their frequency; c. curve of the threshold of auditory sensation on the frequency of sound vibrations; d. the curve of the dependence of the threshold of auditory sensation on the amplitude sound vibrations. **82**. What are the parts of the audiometer? a. generator of sound vibrations with adjustable frequency and intensity, headphones (handsets); b. rectifier and amplifier; c. phonendoscope, amplifier, speaker; d. an electric oscillation generator with an adjustable frequency, intensity, and headphones (telephone handsets). **83**. What is the clinical sound method of auscultation? a. diagnostic method based on the analysis of sounds in the lungs and heart; b. method of auscultation of sounds created by tapping various organs (including lungs); c. diagnostic method based on recording sounds in the heart and lungs;

	d. method of transmitting sounds arising in the heart and lungs for their recording and analysis. **84**. List the sound methods in the clinic. a. ultrasonic location method, audiometry; b. percussion, auscultation, phonocardiography; c. galvanization, audiometry, echoencephalography d. electroencepholography, ultrasonic method for measuring blood flow velocity. **85**. What are the parts of a phonendoscope? a. hollow capsule with sound receiving membrane, sound amplifier; b. receiver, sound generator, rubber tubes; c. hollow capsule with sound transmitting membrane, rubber tubes; d. sound source, hollow capsule with sound transmitting membrane, rubber tubes. **86**. What is called an oscillatory process? a. aperiodic system state change; b. periodic state change of some system; c. any change in the state of the system under the influence of an external force; d. a change in the state of the system due to the energy transferred to it from outside. **87**. What oscillation is called damped? a. oscillation whose logarithmic damping decrement increases b. oscillation during which the attenuation coefficient decreases c. oscillation whose logarithmic damping decrement decreases d. oscillation, the amplitude of which decreases over time. **88**. Definition of percussion - ... a. diagnostic method based on the analysis of sounds arising in organs when they are tapped; b. hearing acuity method; c. method of listening to sounds that accompany the functioning of internal organs; d. one of the methods of ultrasonic location. **89**. List the mechanical processes in a living organism. a. the movement of the walls, valves of the heart, the movement of blood, lungs and other organs; b. generation and distribution of electrical signals in organs; c. movement of electric waves of excitation along nerve fibers; d. transport of molecules and ions through the membrane. **90**. The main types of fluctuations - a. harmonic; b. fading; c. forced and self-oscillations; d. all listed. **91**. At which point are all the ions responsible for the resting potential correctly named? a. K^+, Na^+, Cl^-, Ca^{++}; b. K^+, Na^+, Ca^{++}; c. K^+, Na^+, Cl^-; d. K^+, Na^+, SO^-_4
GPC - 7	**92**. Determining the action potential: a. potential difference that occurs between the cytoplasm of the cell and the environment in a state of physiological rest; b. the potential that occurs inside the cell when it is excited; c. potential that occurs in the membrane when it is excited; d. an electric pulse caused by a change in the ionic permeability of the cell membrane when it is excited. **93**. An electric dipole is a system of two spatially separated charges...

	a. equal in size and opposite in sign; b. equal in size and equally positively charged; c. different in size and opposite in sign; d. equal in size and equally negatively charged. **94**. Current dipole (dipole electric generator) is a two-pole system consisting of ... a. two charges equal in magnitude and opposite sign; b. two charges equal in magnitude and one positive sign; c. two charges equal in magnitude and one negative value; d. source and flow of current.
GPC-7	**95**. X-ray radiation - a. electromagnetic waves with a wavelength from 80 to 10^{-5} nm; b. electromagnetic waves whose wavelength is in the interval from 80 to 300 nm; c. ultrasonic waves, the frequency of which undergoes a change in the range of 10^5-10^9 Hz; d. electromagnetic waves with a wavelength from 400 to 800 nm. **96**. According to the mechanism of formation, the following types of X-ray radiation are distinguished: a. brake and characteristic; b. long-wave and short-wave; c. ultraviolet and infrared; d. microwave and ultra-high frequency. **97**. X-ray tomography method - a. this is a computer version of obtaining an image of organ tissues by registering scattered X-rays; b. this is a computer-based version of radioscopy that allows you to obtain layered images of organs on a computer screen; c. this is a computer version of radioscopy that allows you to obtain an integral image of human organs on a computer screen; d. a method for obtaining an image of tissues on a radioluminescent screen by exposing it to x-rays that have passed through the body. **98**. Radioactivity is … a. spontaneous decay of unstable nuclei; b. electrical activity of ions and free radicals; c. spontaneous synthesis of unstable nuclei; d. the amount of particles formed per unit of time during the decay of radioactive nuclei. **99**. Dosimetry is a branch of nuclear physics and measurement technology that ... a. studies the values that characterize the effect of ionizing radiation on the body, as well as methods and devices for measuring them; b. studies the values that characterize the decay process of radioactive elements, as well as methods and instruments for studying this process; c. studies the activity of radioactive elements; d. develops methods for determining the characteristics of radioactive elements. **100**. The absorbed dose is ... a. the energy of ionizing radiation absorbed by 1 kg of organ tissues b. the charge that occurs in a unit of volume of a substance when it is exposed to ionizing particles c. mass of ionizing radiation absorbed per unit volume of matter for 1 s d. the energy of ionizing radiation absorbed by the substance in 1 s **101**. Ionizing radiation used in medicine is ... a. ultraviolet radiation and the entire range of visible radiation;

	b. ultra-high-frequency, ultra-high-frequency electromagnetic radiation; c. ultrasonic and microwave electromagnetic radiation; d. X-ray and gamma radiation. **102**. X-ray structural analysis of substances is ... a. method for determining the chemical composition of substances by studying the phenomenon of x-ray scattering; b. method for determining the structure of crystals, molecules (for example, DNA) by x-ray diffraction; c. method for determining the atomic structure of a substance by studying the phenomenon of x-ray absorption; d. analysis based on the phenomenon of x-ray dispersion. **103**. Primary processes observed in tissues when exposed to ionizing particles are ... a. full internal reflection; b. excitation and ionization of atoms and molecules; c. photochemical reactions; d. Doppler effect. **104**. Sources of ionizing radiation - ... a. incandescent lamps, gas-discharge lamps; b. strongly heated solids, electrical discharges, gases, placed in a strong magnetic field; c. X-ray tube, nuclei of radioactive atoms, charged particle accelerators; d. UHF-apparatus, microwave, EHF-apparatus. **105**. X-ray radiation is ... a. electromagnetic waves with a wavelength from 80 to 10^{-5} nm; b. electromagnetic waves whose wavelength is in the interval from 80 to 300 nm; c. ultrasonic waves, the frequency of which undergoes a change in the range of 10^5-10^9 Hz; d. electromagnetic waves with a wavelength from 400 to 800 nm. **106**. According to the mechanism of formation, the following types of X-ray radiation are distinguished - a. bremsstrahlung and characteristic; b. long-wave and short-wave; c. ultraviolet and infrared; d. microwave and ultra-high frequency. **107**. X-ray bremsstrahlung radiation occurs … a. as a result of electron deceleration by the electric field of nuclei, the electron shell of anti-cathode atoms; b. in the form of spontaneous radiation of anti-cathode atoms when they interact with high-energy electrons; c. when electrons are decelerated by an external field applied to the anti-cathode of the X-ray tube; d. in the form of thermal radiation of an anti-cathode heated by a stream of accelerated electrons.

b. Questions for current monitoring of academic performance

Competence code	***Evaluation material***
GPC-7	1. Mechanical oscillations. Types of oscillation. The parameters of the oscillations. Units of measurement. 2. Mechanical waves. Type of waves. The parameters of the waves. 3. Viscosity (internal friction) of the liquid. Newton's formula for the internal friction force. 4. The coefficient of viscosity. Units of viscosity measurement. 5. Newtonian and non-Newtonian liquids. Physical features of blood that determine its belonging to non-Newtonian fluids. 6. Distribution of blood viscosity along the bloodstream. Diagnostic value of blood viscosity. 7. Methods for determining the viscosity of the blood. 8. Hemodynamics. Hemodynamic parameters and their relation to the physical parameters of blood and blood vessels. 9. Poiseuille's formula. Hydraulic resistance and its distribution along the bloodstream. 10. Distribution of blood flow rate and blood pressure along the cardiovascular system. 11. The pulse wave. The parameters of the pulse waves. 12. 12. Physical basis of a clinical method for measuring blood pressure.
PC-21	13. Doppler effect. Medical applications of Doppler effect. A formula that relates the velocity of blood particles and changes in the frequency of ultrasound when it is reflected. 14. Sound. Objective (physical) and subjective (auditory) characteristics of sound. Connection between them. Units of measurement. 15. Audiometry. Hearing threshold. The spectral characteristics of the hearing threshold of the ear. 16. Sound methods in the clinic. 17. Ultrasound. Ultrasound parameters. 18. Types of fluid flow. Reynolds number. 19. Physical processes in tissues when exposed to ultrasound. Medical ultrasound applications. 20. Physical bases of methods of ultrasonic location and echo-Doppler studies. 21. Deformation of bodies. Elastic and plastic deformation. Types of deformations. Mechanical stress. Hooke's Law. Elastic modulus. Unit. 22. Graphical dependence of mechanical stress and relative strain. Limits of elasticity and strength. 23. Viscoelastic bodies. Basic mechanical properties of bones, skin, and blood vessels. 24. The structure of muscles. Rheological properties of muscles.
GPC-7	25. The structure of muscles. Rheological properties of muscles. 26. Model of sliding filaments. Hill's Equation. 27. The structure and physical properties of membranes. Structure of lipid molecules. 28. Passive transport of molecules and ions through membranes. The variety of passive transport through membranes. 29. Active ion transport across membranes. Determination of ion pumps. 30. Membrane potentials. The nature of the ions involved in generating membrane potentials. Reasons for generating membrane potentials.

	31. The rest potential. Mechanisms for generating the resting potential. 32. Nernst and Goldman – Hodgkin-Katz Equation. 33. The action potential. The mechanism of generation of action potential. Propagation of action potential along nerve and muscle fibers. 34. The electrical activity of the organs. Dependence of electrical activity of organs on their physiological state. 35. Rheography. Physical basis of rheography. 36. Electric currents. Types and parameters of currents. The threshold of a tangible and non-releasing current. 37. Low-frequency methods of electrotherapy. Physical processes in tissues when exposed to low-frequency currents. 38. Varieties of high-frequency therapy methods. Factors of high-frequency therapy. Physical processes in tissues when exposed to high-frequency factors. 39. Galvanization and electrophoresis. Physical processes in tissues during galvanization 40. The apparatus of galvanization. Principle of operation and device. 41. 41. UHF therapy. Physical processes in conducting and di-electric tissues when exposed to an electric field in the UHF range.
GPC-7	42. Types of electric shock. Thresholds of perceptible and non-releasing currents and their dependence on frequency. 43. The nature of light. Phenomena of interaction of light with bodies. 44. Classification of optical methods and research of diagnostics based on the phenomena of interaction of light with bodies. 45. Absorption of light by transparent solutions. The law of light absorption (the law of the Bouguer-Bera). Transmittance, optical density of solutions. Photoelectrocolorimetry. 46. Features of laser radiation. Medical applications of lasers. 47. Thermal radiation of bodies. Laws Of Stefan-Boltzmann, Wine. 48. Physical basis of thermography. Technical means Termographie. 49. Photobiological processes. Varieties of photobiological processes. 50. The structure of the eye. Parameters of the optical system of the eye. 51. The structure of the visual cells. Physical bases of visual reception. 52. Luminescence. Types of luminescence. 53. Natural and polarized light. Physical bases of polarimetry. Medical application of polarimetry. 54. Ultrasonic, infrared radiation. Medical applications of ultraviolet and infrared radiation. 55. Varieties of ionizing radiation. Methods of obtaining and nature of ionizing radiation. 56. Radioactivity. Law of radioactive decay, constant decay, activity of a radioactive preparation, half-life. 57. Primary processes of interaction of ionizing radiation with body tissues. Medical application of ionizing radiation.
GC-5	58. General scheme of measurement, amplification, transmission, reception and registration of medical and biological information. Classification of removal apparatuses. 59. Requirements for safety when working with electronic equipment. Division of devices and devices of medical electronics depending on the method of protection against electric shock. 60. Lasers. Devices and operating principle of a gas (or ruby) laser.
GPC-7	61. Passive transport of molecules and ions through membranes. The variety of passive transport through membranes.

	62. Active ion transport across membranes. Determination of ion pumps. 63. Membrane potentials. The nature of the ions involved in generating membrane potentials. Reasons for generating membrane potentials. 64. The rest potential. Mechanisms for generating the resting potential. 65. Nernst and Goldman – Hodgkin-Katz Equation. 66. The action potential. The mechanism of generation of action potential. Propagation of the action potential along the nerve and muscle fibers. 67. The electrical activity of the organs. Dependence of electrical activity of organs on their physiological state. 68. Electrography. A type of electrography. Physical foundations of electrocardiography (the main position of the Einthoven theory). 69. The total resistance (impedance) of body tissues to alternating electric current. The impedance formula. 70. The nature of ohmic and capacitive resistance of the tissues. 71. Dispersion of electrical conductivity of body tissues. Medical value of electrical conductivity dispersion. Tarusov's coefficient. 72. Rheography. Physical basis of rheography. 73. Electric currents. Types and parameters of currents. The threshold of a tangible and non-releasing current. 74. Low-frequency methods of electrotherapy. Physical processes in tissues when exposed to low-frequency currents. 75. Varieties of high-frequency therapy methods. Factors of high-frequency therapy. Physical processes in tissues under the influence of high-frequency factors. 76. Galvanization and electrophoresis. Physical processes in textiles during galvanization
PC-21	77. Methods of protection from ionizing radiation. 78. System and practical units of measurement of absorbed, exposure and equivalent doses and their relationship. 79. Medical electronics. Classification of devices and devices of medical electronics. The principle of operation and purpose of electronic devices and apparatuses. 80. Electrography. A type of electrography. Physical basis of electrocardiography (main position of Einthoven's theory). 81. Total resistance (impedance) of body tissues to alternating electric current. The impedance formula. 82. The nature of ohmic and capacitive resistance of the tissues. 83. Dispersion of electrical conductivity of body tissues. Medical value of electrical conductivity dispersion. 84. Tarusov coefficient. 85. The definition of the action potential. 86. Electric dipole 87. Current dipole (dipole electric generator).
	88. Regularities of the biological action of ionizing radiation. 89. Physical bases of radionuclide diagnostics and therapy. 90. X-rays. Nature and method of obtaining x-rays. Primary processes of interaction of x-rays with body tissues. 91. The law of attenuation of x-rays when passing through a substance. Physical basis of radioscopy. 92. Dosimetry of ionizing radiation. Exposure dose. Exposure dose rate. 93. Absorbed dose. Power of the absorbed dose. 94. Equivalent dose and its power. Unit. Quality factor. Dependence of the quality coefficient on the nature of ionizing radiation.

GPC-7: readiness to use basic physical, chemical, mathematical and other natural science concepts and methods in solving professional tasks.

SOLVING TASKS

Task № 1. (GC-1, GPC-7, PC-21)
A steel ball with a diameter of 1 mm was lowered into castor oil and it was determined that it passed 5 cm a distance in 14.2 s. Considering the ball movement to be uniform, determine the viscosity of castor oil if its density is 960 kg/m3, and the steel density is 7860 kg/m3.
The solution:
Problem solution. Three forces act on a ball moving in a viscous liquid:
1) the force of gravity (pointing down) $mg=P=(4/3)\pi R^3 p_{st} g$;
2) Archimedes' repulsive force (directed upwards) $F_A=p_o V g=(4/3)\pi R^3 p_o g$;
3) the friction force determined by Stokes' law (directed upwards) $F=6\pi\eta R v$
4) for uniform motion, the algebraic sum of these forces is zero::
$$P+F_A+F=0$$
5) Solving the equation we get:
$$\eta=(2R^2 g(p_{st}-p_o))9v$$
6) Substituting numerical values we get: η = 1.07 Pa·sec
The answer: η =1,07 Pa·sec

Task № 2 *(*GC -*1,* GC -*5,* GPC -*7,* PC -*21)*
Determine the coefficient of thermal conductivity χ of bone tissue if 68 ***J*** of thermal passes through the area of this bone 3 × 3 cm in size and 5 mm thick in 1 hour. The temperature difference between the external and internal surfaces of the bone in the body is 1^0.
The solution:
We use the law of resistance $Q=(\Delta T/\Delta x)\cdot S\cdot t \rightarrow \chi=(Q\Delta x)/(\Delta T\cdot S\cdot t)$.
Substituting the numerical values we get:
χ = 105 mW / (m·K)
The answer: χ = 105 mW / (m·K)

Task № 3. The intensity ratio of the two sound sources is I_2/I_1=2. What is the difference between the intensity levels of these sounds? *(GC-1, GC-5, GPC-7, PC-21)*
The solution:
$\Delta L=10\cdot lg(I_2/I_1)$ = 10 lg2 = 3dB
The answer: ΔL=3dB

Task № 4. An ultrasound wave with a frequency ν of 5 MHz passes from the soft tissues to the bone. Determine the wavelength λ in both media if the ultrasonic velocity in the first medium is v_1 = 1500 m / s, and in the second v_2 = 3500 m / s. *(GC-1, GC-5, GPC-7, PC-21)*
The solution:
$\lambda = v/\nu$
The answer: $\lambda_1 = 3\cdot10^{-4}$м. $\lambda_2 = 7\cdot10^{-4}$м

Task № 5. The galvanizing apparatus creates a current density of 0.12 mA / cm^2. How much electricity passes through the body if the electrodes applied to the skin surface have an area of 1.5 dm^2 and the galvanization procedure lasts 20 minutes? *(GC-1,GC-5, GPC-7, PC-21)*
The solution:
Current density $j=I/S$, $I=\Delta q/\Delta t$, $\Delta q=I\Delta t=jS\Delta t$.
j=0,12 mA/cm^2=0,12·10^{-3}/10^{-4}=1.2 A/m^2; S=1,5dm^2=0,015m^2; Δt=1200 s.
Substituting the numerical values translated into SI, we obtain: Δq =21,6 Cl.
The answer: Δq =21,6 Cl.

EXAMPLES OF SITUATIONAL TASKS

***Task №* 1.** *(GC-1, GC-5, GPC-7, PC-21)*

During blasting in the mine, the worker was in the field of sound shock. The sound intensity level was L_{max} = 150 dB. As a result he was injury -his eardrum ruptured. Determine the intensity, amplitude value of sound pressure and the amplitude of displacement of particles in the sound wave of a frequency of ν = 1 kHz.

1. *Question*: Specify the formula for the level of this sound.

The answer: $L = 10 \cdot lg\frac{I}{I_0}$

2. *Question*: Determine the intensity of a given sound.

The answer: As follows from the presented formula:

$L_{max} = I_0 \cdot 10^{\frac{I_{max}}{10}} = 10^{-12} \cdot 10^{150/10} = 10^3 = 1000\frac{W}{m^2}$

3. *Question:* Indicate the formula for the intensity of the mechanical wave.

The answer: $I = \frac{p^2}{2\rho \cdot c} = \frac{\rho \cdot A^2 \cdot \omega^2 \cdot c}{2}$

4. *Question*: Calculate the amplitude of a given sound wave.

The answer: The value of the initial data of the task: ρ = 1.29 kg / m^2;

$\omega = 2 \cdot \pi \cdot \nu$ = 6.28·103 1/s; c = 330 m/s.

$P = \sqrt{2 \cdot \rho \cdot c \cdot I} = \sqrt{2 \cdot 1{,}29 \cdot 330 \cdot 1000}$ = 923 Pa

$A = \frac{1}{\omega} \cdot \sqrt{\frac{2 \cdot I}{\rho \cdot c}} = \frac{1}{6280} \cdot \sqrt{\frac{2000}{1{,}29 \cdot 330}}$ = 0,00034 m

***Task №* 2**. *(GC-1, GC-5, GPC-7, PC-21)*

When working in an ***X***-ray room, personnel are exposed to excessive ***X***-ray exposure. It is known that the exposure dose rate at a distance of 1 m from the ***X***-ray source is 0.1 R/min. A person is within 6 hours a day at a distance of 10 meters from the source. What equivalent training dose does he receive during the working day?

1. ***Question*:** Find the exposure dose received by personnel for 6 hours in the ***X***-ray room, at a distance of 1 m from the radiation source.

The answer: $\frac{X}{t} = 0.1\frac{R}{min}$ $X = 0.1\frac{R}{min} \cdot 360\ min = 36\ R$

2. ***Question***: How does the exposure dose rate at a given point depend on the distance to the radiation source?

The answer: $\frac{X}{t} \sim \frac{1}{R^2}$

3. ***Question***: What is the exposure dose received by personnel at a distance of 10m from the source?

The answer: $X = \frac{36}{100} = 0{,}36\ R$

4. ***Question***: How are exposure, absorbed, and equivalent doses related?

The answer: $H = k \cdot D$ $D = f \cdot X$

5. ***Question*:** What equivalent dose does staff receive during 6 hours of the work?

The answer: 0,36 rem.

***Task №* 3.** *(GC-1,GC-5, GPC-7, PC-21)*

In the treatment of tumors, radioactive drugs are used to prolong the irradiation of tumor cells. The activity of a radioactive drug changes over time, so the doctor should evaluate the duration of the possible exposure of the tumor to this drug. The ampoule contains ^{131}**J** radiation iodine with an activity of 100 μCu. What will be the activity of the drug in a day?

***Question*:** How does the activity of a radioactive drug change over time?

The answer: $A = \lambda \cdot N_0 \cdot e^{-\lambda t}$

1. ***Question*:** How are depend the constant of decay of a radioactive drug and its half-decay?

The answer: $\lambda = \frac{ln2}{T_{0.5}}$

2. ***Question*:**
3. Derive the calculation formula for determining the activity of the drug in a day, given that the half-life of radioactive iodine is 8 days.

   The answer: $\frac{A_1}{A_2} = \frac{\lambda \cdot N_0 \cdot e^{-\lambda t}}{\lambda \cdot N_0 \cdot e^{-\lambda(t+1)}} = e^{\lambda}$ $A_2 = \frac{A_1}{e^{\lambda}} = \frac{A_1}{e^{1/8 ln 2}}$
4. ***Question*:** Find the numerical value of the activity of the radioactive drug in a day.
   The answer: A_2=57,8 μCu.

c. Evaluation means of control of Intermediate academic Performance

Code of competency	***Evaluation material***
GC-1, GC-5 GPC-7	**1.** The concept of function and argument. Functional dependence. Forms of representation of functional dependence. Simple and complex functions. **2.** Elementary functions often encountered in practice, their analytical form. **3.** Derivative function. Derivatives of elementary functions. **4.** Differential function. Differentials of functions represented as the sum, difference, product or quotient of two other functions. **5.** Indefinite integral. Table integrals. Constant of integration. Rules of Integration. Methods of integration for non-tabular integrals. **6.** A definite integral. Properties and practical value of certain integrals. **7.** The differential equation. General and particular solutions of differential equations. **8.** General rules for solving a first-order differential equation with separating variables. **9.** Definition of the model, and modeling. Models used in biology and medicine. **10.** A mathematical model of a single injection of a drug into an organ. **11.** A mathematical model of continuous drug administration in an organ. **12.** Ways to quickly achieve a given concentration of a drug in an organ.
GPC-7, PC-21	**13.** Mechanical vibrations. Types of vibrations. Vibration parameters. Units of measurement. **14.** Mechanical waves. Types of waves. Parameters of the waves. **15.** Doppler effect. Medical applications of Doppler effect. A formula that relates the speed of blood particles and changes in the frequency of ultrasound when it is reflected. **16.** The sound. Objective (physical) and subjective (auditory sensations) sound characteristics. The connection between them. Units. **17.** Audiometry. Hearing threshold. The spectral characteristic of the threshold of ear audibility. **18.** Sound methods in the clinic. **19.** Ultrasound. Parameters of ultrasound. **20.** Physical processes in tissues when exposed to ultrasound. Medical applications of ultrasound.

	21. The physical basis of the methods of ultrasonic location and of echo-Doppler studies. **22.** Types of fluid flow. Reynolds number. **23.** The viscosity (internal friction) of the fluid. Newton's formula for the force of internal friction. **24.** The viscosity coefficient. Units of viscosity. **25.** Newtonian and non-Newtonian fluids. Physical features of the blood, determining its belonging to non-Newtonian fluids. **26.** Distribution of blood viscosity along the bloodstream. Diagnostic value of blood viscosity. **27.** Methods of determining blood viscosity. **28.** Hemodynamics. Hemodynamic parameters and their relationship with the physical parameters of blood and blood vessels. **29.** Poiseuille's formula. Hydraulic resistance and its distribution along the bloodstream. **30.** Distribution of blood flow velocity and blood pressure along the cardi-ovascular system. **31.** The pulse wave. Pulse Wave Parameters. **32.** The physical basis of the clinical method for measuring blood pressure. **33.** Deformation of bodies. Elastic and plastic deformation. Types of de-formations. Mechanical stress. Hooke's law. Elastic modulus. Units. **34.** Graphic dependence of mechanical stress and relative deformation. The limits of elasticity and strength. **35.** Viscoelastic bodies. The main mechanical properties of bones, skin, blood vessels. **36.** Muscle structure. Muscle rheological properties. **37.** The model of sliding filaments. Hill's equation. **38.** The structure and physical properties of the membranes. The structure of molecules of lipids. **39.** Passive transport of molecules and ions through membranes. Kinds of passive transport through membranes. **40.** Active transport of ions through membranes. Definition of ion pumps. **41.** Membrane potentials. The nature of the ions involved in the generation of membrane potentials. Reasons of generation of membrane potentials. **42.** Rest potential. Mechanisms of resting potential generation. **43.** The Nernst's and Goldman–Hodgkin-Katz's equation. **44.** The potential of action. Mechanism of generating of action potential. Distribution of action potential along nerve and muscle fibers. **45.** Electrical activity of organs. Dependence of the electrical activity of organs on their physiological state. **46.** Electrography. Kind of electrography. Physical fundamentals of elec-trocardiography (the main point of the Einthoven's theory). **47.** The total resistance (impedance) of body tissues to alternating electric current. Impedance formula. **48.** The nature of ohmic and capacitive resistance of tissues.

	49. Dispersion of the electrical conductivity of body tissues. The medical value of the dispersion of electrical conductivity. Tarusov coefficient. **50.** Rheography. The physical basis of rheography. **51.** Electric currents. Varieties and parameters of currents. Threshold of tangible and non-releasing current. **52.** Low-frequency methods of electrotherapy. Physical processes in tissues when exposed to low-frequency currents. **53.** Varieties of high-frequency therapy methods. High-frequency therapy factors. Physical processes in tissues when exposed to high-frequency factors. **54.** Galvanization and electrophoresis. Physical processes in tissues during galvanization. **55.** Apparatus of galvanization. The structure and principle of operation. **56.** UHF - therapy. Physical processes in conducting and dielectric tissues when exposed to the UHF range by an electric field. **57.** Medical electronics. Classification of medical electronics devices and apparatus. The principle of operation and purpose of electronic devices and apparatus. **58.** The general scheme of measuring, amplification, transmission, reception and registration of medical and biological information. Classification of removable devices. **59.** Safety requirements for working with electronic equipment. The division of medical electronics devices and apparatuses depending on the method of protection against electric shock. **60.** Varieties of electric shock. Thresholds of tangible and non-releasing currents and their dependence on frequency. **61.** The nature of light. The phenomena of the interaction of light with bodies. **62.** Classification of optical methods of diagnostic and studies based on the phenomena of the interaction of light with bodies. **63.** Light absorption by transparent solutions. The law of absorption of light (Bouguer-Baire's law). Coefficient of light transmittance and of optical density of solutions. Photoelectrocolorimetry. **64.** A laser. The structure and principle of operation of a gas (or ruby) laser. **65.** Features of laser radiation. Medical applications of lasers. **66.** Thermal radiation of bodies. The laws of Stefan-Boltzmann and, Wine's. **67.** The physical basis of thermography. Technical means of thermography. **68.** Photobiological processes. Varieties of photobiological processes. **69.** The structure of the eye. Parameters of the optical system of the eye. **70.** The structure of visual cells. The physical bases of visual reception. **71.** Luminescence. Varieties of luminescence. **72.** Natural and polarized light. Physical principles of polarimetry. Medical application of polarimetry.

	73. Ultrasonic, infrared radiation. Medical applications of ultraviolet and infrared radiation. **74.** Varieties of ionizing radiation. Methods of production and nature of ionizing radiation. **75.** Radioactivity. **76.** The law of radioactive decay, constant of decay, activity of a radioactive drug, half-life. **77.** The primary processes of interaction of ionizing radiation with body tissues. Medical application of ionizing radiation. **78.** The legitimacies of the biological effect of ionizing radiation. **79.** The physical basis of radionuclide diagnostics and therapy. **80.** X-rays. The nature and methods of obtaining X-rays. The primary processes of interaction of X-rays with body tissues. **81.** The law of attenuation of X-rays when passing through a substance. Physical fundamentals of fluoroscopy. **82.** Dosimetry of ionizing radiation. Exposure Dose. Exposure dose rate. **83.** Absorbed dose. Absorbed dose rate. **84.** Equivalent dose and its power. Units of measurement. Coefficient of Quality. Dependence of the coefficient of quality on the nature of ionizing radiation. **85.** Methods of protection against ionizing radiation. **86.** Systemic and practical units of measurement of absorbed, exposure and equivalent doses and their relationship.

APPROXIMATE ASSESSMENT MEANS FOR CARRYING OUT INTERMEDIATE CERTIFICATION
Examination ticket forms

FSBEI IN DGMU Ministry of Health of Russia
Faculty of General medicine

APPROVED:

Dean of the Faculty of General medicine

prof. Ragimov R.M _____

« _____»_____2020 y.

EXAMINATION TICKET
ON PHYSICS, MATHEMATICS
FOR STUDENTS 1 COURSE OF MEDICAL FACULTY

TICKET № 1

1. The sound. Objective and subjective characteristics of sound. Sound methods in the clinic.
2. Types of ionizing radiation. The primary processes of interaction of ionizing radiation with body tissues.
3. Table integrals. Newton-Leibniz's formula.

Head of the Department, associate Professor *M.A. Magomedov*

FSBEI IN DGMU Ministry of Health of Russia
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EXAMINATION TICKET
ON PHYSICS, MATHEMATICS
FOR STUDENTS 1 COURSE OF MEDICAL FACULTY

TICKET № 2

1. Low-frequency methods of electrotherapy. Physical processes in tissues when exposed to low-frequency currents.
2. Membrane electrical potentials. Reasons of the generation of membrane potentials.
3. First-order differential equations with separable variables and methods for their solution.

Head of the Department, associate Professor *M.A. Magomedov*

FSBEI IN DGMU Ministry of Health of Russia
Faculty of General medicine

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« _____»_____2020 y.

EXAMINATION TICKET
ON PHYSICS, MATHEMATICS
FOR STUDENTS 1 COURSE OF MEDICAL FACULTY
TICKET № 3

1. Radioactivity. The law of radioactive decay, constant of decay, activity of a radioactive drug, half-life.
2. Absorption of light by transparent solutions. The law of absorption of light (Bouguer-Baire's law).
3. Galvanization and electrophoresis. Physical processes in tissues during galvanization

Head of the Department, associate Professor *M.A. Magomedov*