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ФИО: Стегний Кирилл Владимирович
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Federal State Budget Educational Institution
of Higher Education
Pacific State Medical University
of the Ministry of Health of the Russian Federation

APPROVED BY
First Vice-Rector
_____ / Trankovskaya L.V./
"9" июня 2025

DISCIPLINE WORK PROGRAM

Б1.О.05 Medical physics

(name of discipline)

Specialty	**31.05.01 General Medicine for international students (in English)** (code, name)
Degree	Specialist's degree
Profile	02 "Healthcare" (in the field of providing primary health care to the population in medical organizations: polyclinics, outpatient clinics, inpatient/outpatient facilities of the municipal health care system)
Mode of study	Full-time
Period of mastering the BEP	**6 years** (nominal length of study)
Institute	of Fundamentals and Information Technologies in Medicine

Vladivostok, 2025

Program of the discipline **Б1.О.05 Medical physics** is based on:
1) Federal State Educational Standard of Higher Education for the specialty approved by the Order No. 988 of Ministry of Science and Higher Education of the Russian Federation
dated August 12, 2020.

2) Curriculum for the 31.05.01 General Medicine for international students (in English), profile 02 "Healthcare" (in the field of providing primary health care to the population in medical organizations: polyclinics, outpatient clinics, inpatient/outpatient facilities of the municipal health care system), approved by the Academic Council of FSBEI HE PSMU of the Ministry of Health of Russia, Report No. 8/24-25 dated March 31, 2025.

Work program for the discipline was developed by the writing team of the Institute of Fundamentals and Information Technologies in Medicine of the FSBEI HE PSMU of the Ministry of Health of Russia, under the guidance of the director of the institute Candidate of Medical Sciences Bagryantsev V.N.

Developed by:

Lecturer	Master in applied physics	Rivas Velasquez Daniel Alejandro
(position held)	(academic degree, academic title)	(full name)

1. GENERAL PROVISIONS

1.1. Purpose and Objectives of Mastering Б1.О.05 Medical physics

The purpose of mastering the discipline is to acquire systemic knowledge about basic physical phenomena and principles, their connections with biological processes and characteristics of bio-materials of the human body, as well as to learn to calculate the main parameters of physical processes using experimental and mathematical methods to quantify error margins.

Objectives of mastering the discipline:

1. Learn about physical phenomena affecting the human body and their application in diagnosis and medical treatment;
2. Acquire practical skills necessary to setup and perform experimental work with subsequent mathematical processing of the obtained data;
3. Develop skills of using modern digital tools and technologies;
4. Develop comprehension skills when working with scientific literature;
5. Develop personal characteristics necessary for the implementation of the formed competencies in professional activity.

2. DISCIPLINE AS PART OF THE BASIC EDUCATIONAL PROGRAM

Discipline **Б1.О.05 Medical physics** is included in the Mandatory part of the Unit 1 of the basic educational program for the specialty 31.05.01 General Medicine for international students (in English), profile 02 "Healthcare" (in the field of providing primary health care to the population in medical organizations: polyclinics, outpatient clinics, inpatient/outpatient facilities of the municipal health care system), and is part of the 1st and 2nd semesters' curriculum.

3. PLANNED LEARNING OUTCOMES OF THE DISCIPLINE

3.1. Mastering the discipline **Б1.О.05 Medical physics** is aimed at the development of students' competencies. The discipline facilitates the development of students' competencies corresponding to the types of professional activity.

Name of competency category (group) / Labor function	**Code and Name of competency of the graduate**	**Competency Indicators**
General Professional Competencies		
Instrumental Diagnostics	GPC-4. Is able to use medical devices included in the healthcare guidelines, as well as perform medical examination to make a diagnosis	CI.GPC-4_1- uses medical devices for diagnosis, treatment and rehabilitation in accordance with healthcare guidelines CI.GPC-4_2- performs medical examination of a patient using basic and general clinical skills, laboratory tests and diagnostic procedures CI.GPC-4_3- evaluates medical examination results in order to make a diagnosis
Etiology and pathogenesis	GPC-5. Is able to assess morphofunctional status, physiological states, and pathological processes in the human body when working to achieve objectives of professional activity	CI.GPC-5_1- assesses the morphofunctional state based on the acquired knowledge CI.GPC-5_2- distinguishes between pathological and physiological processes, identifies etiology of changes CI.GPC-5_3- provides diagnostic assessment of the identified changes
Professional Competencies		
A/02.7 Examination of the	PC-3 Ability and readiness	CI.PC-3_3- selects required additional

patient in order to make a diagnosis	to collect and analyze complaints that a patient presents with, anamnestic data, examination results, results of laboratory and instrumental tests, biopsy and other studies in order to identify patient's condition or establish the presence or absence of a disease	diagnostic methods, evaluates their results in order to recognize patient's condition, establish the presence or absence of the disease

3.2. Types of professional activity corresponding to competencies developed over the course of mastering **Б1.О.05 Medical physics**:

Types of professional activity objectives

1. *Medical*

Kinds of professional activity objectives

1. *Diagnostics*
2. *Treatment*

3.3. Planned learning outcomes of mastering the discipline are represented by knowledge, skills, abilities and/or experience, characterize the stages of developing competencies and ensure achievement of the planned outcomes of mastering the basic educational program. Learning outcomes of a discipline are correlated with competency indicators.

4. SCOPE AND CONTENT OF THE DISCIPLINE

4.1. Scope of the Discipline and Types of Academic Work

Type of Academic Work		**Total Hours**	**Semesters**	
			1	**2**
			hours	**hours**
1		2	3	
Classroom hours (total), including:		**96**	**48**	**48**
Lectures (L)		24	12	12
Practical classes (C)		72	36	36
Independent work of the student (IW), including:		**48**	**24**	**24**
Preparing for classes (CP)		16	8	8
Preparing for continuous assessment (CAP)		16	8	8
Preparation for interim assessment (IAP)		16	8	8
Interim assessment				
Type of interim assessment	pass/fail test (T)	T		T
	exam (E)			
TOTAL: TOTAL credit value	hrs.	**144**	**72**	**72**
	credits	**4**	**2**	**2**

4.2. Contents of the Discipline

4.2.1. Topics of Discipline Lectures and Academic Hours per Semester

No.	Lecture Topic	Hours
1	2	3
	Semester No. 1	
1.	Introduction to physics, its role in medicine, Medicine and medical devices, Units of measurement (Metrology), Coordinate Systems	2
2.	Newton’s laws and gravity. Biomechanics. Deformations and mechanical properties of biomaterials	2
3.	Acoustics. Sound, its physical and physiological characteristics. Doppler’s effect. Ultrasound imaging	2
4.	Fluid mechanics. Surface tension. Properties of liquids and mechanics of biofluids. Pressure and barotrauma	2
5.	Thermodynamics and biopotentials, Laws of thermodynamics, statistics and probability, Entropy and potentials, Membranes	2
6.	Electrostatic potential, electrical field and flow, resistance, capacitance, and inductance	2
Hours per semester total		**12**
	Semester No. 2	
1.	Electrical processes in cells and organs. Electromagnetic properties of biological tissue. Principles of medical use of electrical and electromagnetic fields	2
2.	Electro cardiology, Magnetic fields and spectrometers	2
3.	Linear optics and optical phenomena. Reflection and refraction, optical systems and the human eye	2
4.	Basis for diagnostic methods using quantum optics, electromagnetic waves, polarization, material refraction	2
5.	Fundamentals of ionizing radiation, X-ray and gamma radiation, biological effects, dosimetry and their medical applications	2
6.	Atomic physics. Luminescence and atomization, isotopes, isotope-dating and tagging	2
Hours per semester total		**12**

4.2.2. Topics of Discipline Practical Classes and Academic Hours per Semester

No.	Practical Class Topic	Hours
1	2	3
	Semester No. 1	
1	Newton’s laws of motion. Work and energy. Rotational motion and relative characteristics Laboratory class No.0: Linear measurements and error margins	4
2	Mechanical equilibrium. Mechanical advantage (Levers) Practical exercise No.1: Pulleys and levers	4
3	Mechanical properties of solid materials. Linear and tangential deformation. Shear, compression, bending, and torsion Laboratory class No.1: Mechanical oscillations	4
4	Mechanical properties of biological materials. Rheological properties of bone tissue. Rheological properties of muscle tissue Laboratory class No.2: Young's modulus	4
5	Characteristics and types of oscillations. Superposition and decomposition of oscillations. Mechanical waves. Wave energy flux. Sound characteristics and auditory sensations. Practical use of mechanical waves in medicine Laboratory class No.3: Doppler’s effect	4
6	Fluid mechanics. Stationary flow. Continuity condition. Stream tube. Stream line.	4

	Viscosity of a liquid. Flow of viscous liquid through a pipe. Bernoulli's principle Practical exercise No.2: Fluid mechanics and pressure	
7	Physical foundations of hemodynamics. Models of the circulatory system. Heart function Laboratory class No.4: Measuring blood pressure	4
8	Electrical field of stationary charges. Coulomb's law. Interactions of matter in an electrical field. Magnetic fields. Basics of electrical circuits Practical exercise No.3: Electric fields and Om's laws	4
9	Properties bio-tissues in direct current (DC). Practical applications of DC. Pulse currents Laboratory class No.5: DC in biomaterials	4
Hours per semester total		**36**
	Semester No. 2	
10	Alternating current (AC) circuits. Properties of AC in biotissues. Practical applications of AC Laboratory class No.6: AC in biomaterials	4
11	Characteristics of electromagnetic fields (EMF). Radio-micro wave spectrum in medicine Laboratory class No.7: Magnetic field measurement	4
12	Electrography. Biopotentials of a cell. Current dipole. Electrocardiography. Electromyography Practical exercise No.4: Electrocardiography	4
13	Light properties. Interference and diffraction of light. Absorption and scattering. Thermal radiation Practical exercise No.5: Linear optics	4
14	Refraction of light. Refractometry. Dispersion. Spectroscopy. Polarization of light and Polarimetry. Thin lenses and optical systems. Microscopy Laboratory class No.8: Linear optics	4
15	Optical properties of molecules. Luminescence. Photoluminescence. Chemiluminescence. Electroluminescence. Optical quantum generators (Lasers) Laboratory class No.9: Colorimetry and polarimetry	4
16	Fundamentals of ionizing radiation. X-ray radiation. X-rays and matter interactions. Physical methods of X-ray radiation and medical applications Laboratory class No.9: Colorimetry and polarimetry	4
17	Physical foundations and medical use of radioactive radiation. Radioactive decay. Properties of radioactive radiation. Dosimetric units of ionizing radiation Practical exercise No.6: Dosimetry	4
18	Biological effects of ionizing radiation. Radionuclides in medicine Practical exercise No.7: Interim assessment	4
Hours per semester total		**36**

4.2.3. Independent Work of the Student

No.	Name of the Discipline Section	Type of IW	Total Hours
1	3	4	5
	Semester No. 1		
1	Introduction to physics and medical physics, bio-mechanics and characteristic of bio-materials	Preparing for practical classes, preparing for tests, preparing reports on the results of the laboratory class, preparing slides presentations on specific topics	24
	Semester No. 2		
Hours per semester total			**24**

2	Biological interactions of electro-magnetic fields, introduction to quantum-atomic effects and spectroscopy	Preparing for practical classes, preparing for tests, preparing reports on the results of the laboratory class, preparing slides presentations on specific topics	24
Hours per semester total			**24**

5. REQUIREMENTS FOR IMPLEMENTATION OF DISCIPLINE

5.1. Discipline Requirements for Educational Materials and Provided Information

Essential reading

No.	Name/Title, Resource Type	Author(s)/Editor	Publisher Imprint, Web Address	Number of Copies (accesses) in the Library and Information Center
1	**2**	**3**	**4**	**5**
1	Remizov A. N. Medical and biological physics : textbook	A. N. Remizov	M. : GEOTAR-Media, 2022. - 576 c. http://www.studmedlib.ru	20

Supplementary reading

No.	Name/Title, Resource Type	Author(s)/Editor	Publisher Imprint, Web Address	Number of Copies (accesses) in the Library and Information Center
1	**2**	**3**	**4**	**5**
1	Biological physics	A. I. Kozlov	Витебск : ВГМУ, 2021. - 191 с. https://www.books-up.ru	Unlimited access

Online resources

1. Electronic library system "Student Consultant" http://studmedlib.ru/
2. Electronic library system "University Library Online"http://www.biblioclub.ru/
3. Electronic library system "Urait" https://urait.ru/
4. Electronic library system "BookUp" https://www.books-up.ru/
5. Resources owned by the Library and Information Center of FSBEI HE PSMU of the Ministry of Health of Russia https://tgmu.ru/university/bibliotechno-informacionnyj-centr/resursy-bic/sobstvennye/

Online resources and respective user guides are available on the Library and Information Center website Library and Information Center — PSMU (tgmu.ru)

5.2. Discipline Requirements for Facilities and Resources

Information on the facility and resource availability and requirements of the discipline is available on the Facility and resource availability and requirements. FSBEI HE PSMU of the Ministry of Health of Russia (tgmu.ru)" page of the official website of the university.

5.3. List of Information Technologies, Information and Reference Systems, Licensed and Free Software (Including Domestically-developed Software):

1. PolycomTelepresence M100 Desktop Conferencing Application (Videoconference system)
2. SunRav Software tTester
3. 7-PDF Split & Merge
4. ABBYYFineReader
5. Kaspersky Endpoint Security
6. INDIGO online testing system
7. Microsoft Windows 7
8. Microsoft Office Pro Plus 2013
9. 1C:University
10. GARANT system
11. MOODLE (Modular Object-Oriented Dynamic Learning Environment)

6. ASPECTS OF THE IMPLEMENTATION OF THE DISCIPLINE FOR STUDENTS WITH DISABILITIES AND SPECIAL NEEDS

6.1. Availability of Accessible Environment

For students with disabilities and special needs, if a written application is submitted, lectures and practical classes are carried out taking into account health limitations, individual capabilities and medical status (hereinafter referred to as individual characteristics) of the student. Compliance with the following general requirements is ensured: teaching aids for collective and individual use are provided, required technical assistance is provided by an assistant; buildings and premises where lectures and practical classes are taking place meet accessibility requirements, other arrangements lack of which makes it impossible or difficult to master the discipline are made.

6.2. Ensuring Compliance with General Requirements

When lectures and practical classes are carried out at the written application of the student, the following general requirements are met: lectures and practical classes for students with disabilities and special needs take place at the same location as for students who do not have disabilities, if this does not cause difficulties for students; an assistant (assistants), who provide(s) students with the necessary technical assistance taking into account individual characteristics of the student, is (are) provided; necessary teaching aids are provided, taking into account individual characteristics of the student.

6.3. Availability of the Internal Policies and Procedures of FSBEI HE PSMU of the Ministry of Health of Russia to Students with Disabilities in a Format Accessible to Them.

All internal policies and procedures of FSBEI HE PSMU of the Ministry of Health of Russia concerning the discipline are made available to students with disabilities in a format accessible to them.

6.4. Increase in the Time Limit of Interim Assessment for Students with Disabilities and Special Needs in Relation to the Established duration

Format of the interim assessment of academic performance within the scope of the discipline conducted for students with disabilities and special needs is selected taking into account individual characteristics of the students (orally, by writing on paper, by typing on a computer, as a test, etc.). The duration of the interim assessment in relation to the established duration is increased at the written application of the student with disabilities. Time limit for the student's preparation for the test is increased by at least 0.5 hours.

7. STAFFING REQUIREMENTS OF THE DISCIPLINE

Academic teaching personnel that ensure the implementation of the discipline education process meet the requirements of the Federal State Educational Standard of Higher Education for the 31.05.01 General Medicine for international students (in English) specialty; list of the aforementioned personnel is available on the website of the educational organization.

8. TUTORIAL WORK

Type of tutorial work	Forms and approaches to tutorial work	Assessment criteria
Assistance in personal growth	Overt Talks and problem-centric debates aimed at promotion of healthy lifestyle. Participation in interdepartmental conferences aimed at formation of healthy lifestyle and development of skills necessary to preserve and improve health.	Portfolio
	Covert – creating atmosphere and infrastructure. Developing a culture of healthy lifestyle, the ability to preserve and improve health. Creating atmosphere of kindness and respect with a high level of communication during implementation of the discipline.	
Civic position and values	Overt Conducting events that facilitate development of civil culture (roundtable discussions, discussions/debates, and talks). Short discussions on current significant events in case the latter occur.	Portfolio
	Covert Focusing on civic values-oriented position and legal awareness. Cultivating mindful social position during professional activity.	
Social values	Overt Highlighting aspects of organization of healthy lifestyle based on health-preserving technologies. Highlighting ecology-related questions, environmental issues as a factor affecting population health and select population risks.	Portfolio
	Covert Identification in social structure during period of education and in professional activity.	