**FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION**

**HIGHER EDUCATION INSTITUTION**

«DAGESTAN STATE MEDICAL UNIVERSITY»

**MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION**

***Abstract***

***of the work 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 с.u***./***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***

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.

1. **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:** todescribe 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. |
| **GСС-*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. |

1. **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) | | 36 | 36 |
| Type of intermediate certification | | credit | |
| Total: total labor intensity | hours | 108 | 108 |
| credits | 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 |

* 1. 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.

Types of control: **credit**.