MINISTRY OF EDUCATION AND SCIENCE OF the KYRGYZ REPUBLIC

Government-run Educational Institution of Higher Professional Education
Kyrgyz-Russian Slavic University
Institute of Clinical Medicine and Biomedical Technologies

Endorsed by
the Director, Assoc. Prof. *Abilova S.S.*
04.11.2026 y.

Medical biophysics

Course Outline (Module)

Assigned to the department of	**Physics, Medical Informatics and Biology**
Academic Curriculum	560001 – KR General Medicine
Qualification	**Specialist**
Mode of Study	**Intramural**
Total credit value	2 Credit points

Hours of curriculum	60
including:	
In-class sessions	30,3
Independent work	29,7

Types of assessment per semester:
Tests with a grade of 1

Course Hours Scheduling (per semester)

Semester Academic Year	**1(1.1)**		**Total**	
Weeks	18			
Type of Training	EP	WP	EP	WP
Lectures	14	14	14	14
Practical Session	16	16	16	16
Learning communication during the period of theoretical training	0,3	0,3	0,3	0,3
Including interactive	2	2	2	2
Total in class Session	30	30	30	30
Auditorium Learning	30,3	30,3	30,3	30,3
Individual work	29,7	29,7	29,7	29,7
Total	60	60	60	60

The Program is designed by

Svetlana Ts. Manzhikova, PhD in Engineering, Docent

Reviewers:

Aitymbetova A.N., PhD in Physics and Math, KRSU; Ismailova Ch.S., Phd in Biology, IHSM

The Work Program of the Discipline

Medical Biophysics

Is developed in accordance with the State Educational Standard of the Higher Professional Education of the Kyrgyz Republic in the specialty 560001: General Medicine

(Order No. 1357/1 of the Ministry of Education and Science of the Kyrgyz Republic dated July 30, 2021 No. 10822 dated August 3, 2021 of the Ministry of Justice of the Kyrgyz Republic)

composed on the base of curriculum:

The Specialty: 560001-KP "General Medicine" (for foreign students)

approved by the scientific council of the university on 26.06.2026 (protocol № 11)

Work Program was adopted at the meeting of the Department of **Physics, Medical Informatics and Biology**

Protocol № 1 by 26 08 202 6 ,
Valid Duration of the program: 2026-2031 ac. y.
Head of Department, Ph.D. in Physics & Math., Docent E. I. Kondratieva

Approved by the HEP:

1. THE PURPOSE OF LEARNING	
1.1	Contribute to the mastery of mathematical apparatus necessary for solving theoretical and practical problems by medical students, the development of students' ability to self-study of mathematical literature and the ability to express the natural science and clinical problems by mathematical language.
1.2	To promote formation by medical students of the system knowledge about the physical properties and physical processes occurring in biological objects, including the human body, necessary for the development of other academic disciplines and the formation of professional medical qualities.
1.3	Formation by students' logical thinking, the ability to formulate accurately the problem, the ability to isolate the main and secondary, the ability to draw conclusions based on the results of measurements.

2. DISCIPLINE AS A PART OF THE STRUCTURE OF B.E.P.	
Cycle (section) OOП:	B1.B
2.1	**Requirements for pre-training of the student:**
2.1.1	School course of physics and mathematics (Know: mathematical methods of solving problems; the basic laws of physics. Be able: to state physical and mathematical laws and theorems. Skills: solve physical and mathematical problems).
2.2	**Disciplines and practices for which the study of this discipline (module) is necessary as a prior:**
2.2.1	Chemistry and Biochemistry
2.2.2	Normal and Pathological Physiology
2.2.3	Medical Informatics
2.2.4	Probative Medicine
2.2.5	Physiotherapy

3. THE COMPETENCE OF THE LEARNER, FORMED AS A RESULT OF LEARNING (MODULE)	
GK – 3 - Capable of independently acquiring new knowledge and applying it practically using modern information technologies in professional activities.	
To know:	
Level 1	key sources of professional information, methods for the independent search and analysis of knowledge, and modern information technologies and their capabilities for addressing professional tasks.
To be able:	
Level 1	- independently locate, analyze, and systematize professional information; - apply modern information technologies to solve standard professional tasks; and critically evaluate the reliability of sources.
To master:	
Level 1	- skills for independently acquiring new knowledge and methods for its practical application using modern information technologies; - and the capacity for continuous self-education and professional development
PK – 5 - Is able and ready to work with medical and technical equipment used in work with patients, to apply the capabilities of modern information technologies to solve professional problems	
To know:	
Level 1	- basic biological concepts - basic scientific medical and biological terminology - the main sources of information, bibliographic resources, the methodology for processing scientific and technical information on the Internet and specialized databases, the main methods of working with specialized software for solving standard problems of professional activity
To be able:	
Level 1	- use biomedical terminology, information and communication technologies, incl. research methods for solving standard problems of professional activity - apply basic research methods to solve professional problems - apply information, bibliographic resources, processing methods, search for scientific and technical information using general and specialized databases and use specialized software when carrying out theoretical calculations and processing experimental data to solve standard problems of professional activity
To master:	

Level 1	- elementary methods of work in a biological, physical, chemical laboratory; general safety rules for handling computers, laboratory equipment and chemical reagents - biomedical and other terminology; skills of mathematical, biological, chemical and biochemical thinking, skills of independent work with reference, educational and scientific literature - skills in working with scientific and educational portals, basic skills in using standard as well as specialized software and databases for statistical processing of research results and presenting them to the scientific community
AK – 1 - Capable of applying fundamental physicochemical, mathematical, and natural science concepts and methods to solve professional problems.	
To know:	
Level 1	fundamental physicochemical, mathematical, and natural-science concepts, laws, and methods necessary for understanding life processes, as well as the diagnosis and treatment of diseases.
To be able:	
Level 1	apply physicochemical, mathematical, and natural science methods to analyze biomedical processes, interpret laboratory data, and solve diagnostic and research problems.
To master:	
Level 1	skills in the integrated application of physicochemical, mathematical, and natural science methods to solve professional problems; the ability to integrate natural science knowledge into clinical practice and scientific research.

As a result of the development of the discipline the student must:

3.1	**To know:**
3.1.1	The most common physical laws underlying the processes occurring in the body.
3.1.2	Physical properties of biological tissues and fluids.
3.1.3	Characteristics of physical factors (medical, climatic, industrial) that affect the body, biophysical mechanisms of such impact.
3.1.4	Physical characteristics of the information at the output of the medical device. Purpose and technical characteristics of the main types of medical equipment, safety when working with equipment.
3.1.5	Fundamentals of differential and integral calculus.
3.1.6	The theory of ordinary differential equations of the first order with separable variables.
3.1.7	Fundamentals of statistical methods in clinical and laboratory experimental studies.
3.2	**To be able to:**
3.2.1	Make physical measurements and statistically process of the results of measurements; extract the necessary information from the results of observations and measurements. Make an analysis research results given in graphical and analytical forms.
3.2.2	Draw up protocols of laboratory work according to the requirements; to describe the meaning of physical quantities, using physical terminology; give a verbal description of the main physical experiments.
3.2.3	Work on laboratory equipment.
3.2.4	Find derivatives and integrals; apply differentials in approximate calculations.
3.2.5	To compose and solve differential equations on the examples of problems of physical, chemical, pharmaceutical and medico-biological content.
3.3	**To master:**
3.3.1	Problem solving skills based on the laws of mathematics.
3.3.2	Skills of the experiment (competently conduct the experiment; clearly represent the purpose of the study; possess various forms of illustrative expression of the results obtained in the experiment – the construction of graphs, polygons, histograms, tables).
3.3.3	Methods of statistical processing of medical and biological information. Data reliability assessment.
3.3.4	Methods of analysis of new scientific and educational literature, experimental results.

4. THE STRUCTURE AND CONTENT OF THE DISCIPLINE (MODULE)							
Lesson code	**Name of sections and topics /type of lesson/**	**Semester / Course**	**Hours**	**Competences**	**Literature**	**Interact.**	**Note**
	Section 1. Mathematics						

1.0	Differential equations in medicine and biology /Practical class/	1	1	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	Here are considered the linear differential equations of the 1-st and 2-nd order which are usual for medicine and biology and met as mathematical models to explain their different phenomenons.
1.1	Fundamentals of the theory of probability. Random events and quantities. /Practical class/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	Here are considered: Fundamentals of the theory of probability. Random events and quantities. Random events, their relative frequency and probability are considered; addition and multiplication of the events' probability, calculation of the total probability; Bayes' theorem; discrete and continuous random variables and their application to solve problems, including biomedical content.
1.2	Fundamentals of mathematical statistics. / Practical class /	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	The following concepts are considered: Distribution, distribution series, distribution polygon of a discrete random variable. Distribution function and its graph. Methods for finding the position of the distribution center. Variability of the values of a random variable. Distribution density, distribution curve of a continuous random variable and their application to solving problems, including biomedical content.
1.3	Mathematical processing of biomedical data. / Practical class/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	The following basic concepts are considered: The concept of statistical evaluation. Checking the sample for homogeneity. Confidence interval for the mathematical expectation of the general population. Estimation of random errors of direct measurements Testing hypotheses about the equality of the parameters of independent normal sets of random variables. Estimation of random errors of indirect measurements.

							Accounting for Instrumental Error Rules for Actions on Approximate Numbers.
1.4	Elements of the theory of correlation. / Practical class/	1	1	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	The types of dependencies between two random variables are considered. The correlation dependence is analyzed; the correlation coefficient and its properties are considered. The problems of calculating the correlation coefficient of biomedical experimental data are solved and conclusions are drawn.
1.5	Solving problems of medical and biological content in mathematics. /Ind.work/	1	9	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0	To perform the Ind.Work is necessary to refer to the textbook "Higher mathematics" (L 1.1) where all the tasks for Ind.Work are listed and examples of their solutions are presented.
	Section 2. Physics (oscillations and waves, acoustics, flow and properties of liquids, electricity)						
2.1	Mechanical oscillations and waves /Lc/	1	1,5	GK-3 PK – 5 AK – 1			Questions are considered: 1. Harmonic oscillations. The energy of the harmonic oscillations. Free, damped and forced mechanical oscillations. Resonance. 2. Superposition of harmonic oscillations. Decomposition of complex oscillations in the Fourier series. Fourier’s theorem. 3. Application of harmonic analysis for the processing of diagnostic data. 4. Mechanical waves, energy flux and wave intensity.
2.2	Acoustics /Lc/	1	1,5	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Questions are considered: The nature of sound. Physical characteristics of sound. Characteristics of the auditory sensation. Physical foundations of sound research methods in the clinic. Ultrasound and its application in medicine. Infrasound.

2.3	Flow and properties of Liquids. /Lc/	1	1,5	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Issues under consideration • The flow of a viscous fluid. Basic law of viscous flow. Bernoulli equation. • Laminar flow of liquids. The Pouseil formula. • Turbulent fluid flow. Reynolds number. • The main indicators of hemodynamics: a) linear and volumetric velocities of blood flow, b) blood pressure. • Pulse wave. • Physical basis of pressure measurement.
2.4	Elements of biomechanics. Mechanical properties of bones and blood vessels tissues /Lc/ .	1	1,5	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Issues under consideration • Deformation and its types. • The main characteristics of the deformation. Hooke's law for elastic deformation. • Rheological modeling of biological tissues. • Mechanical properties of biological tissues: a) mechanical properties of bone tissue; b) mechanical properties of the blood vessels tissues.
2.5	Electrical properties of tissues and organs. Action of domestic electric current on the human body. External electric fields of tissues and organs /Lc/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Issues under consideration •Basic electrical properties body tissues. •Electrical conductivity of cells and tissues with direct current. Polarization and its types. •Electrical conductivity of cells and tissues with alternating current. Dispersion of the impedance. • Application of electric current with medicinal purpose. •Biophysical principles of electrical research of fields of tissues and organs. Electric field potential, generated by the unipole and dipole. Dipole equivalent electric heart generator. •Vector electrocardiography. Einthoven's theory

2.6	Theory of bio potentials /Lc/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Issues under consideration •Diffusion, membrane and phase biopotentials. •Resting potential. Goldmann equation. •Action potential. Axon action potential nerve cell. The Hodgkin–Huxley equation.
2.8	X-ray radiation /Lc/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Issues under consideration • Nature and basic properties of x-rays. X-ray tube device. • Ways of excitation of x-ray radiation. • Interaction of X-rays with substance. • The use of X-rays in medicine.
2.9	Elements of a nuclear Biophysics /Lc/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1		Considering Questions: • Stability of the atomic nucleus. Radioactivity and its types. • Basic law of radioactive decay. • Penetrating and ionizing abilities of radioactive radiation. • Dosimetry of ionizing radiation. • Biological effect of radioactive radiation on people
2.10	The study of vibrational movements with kymograph. /Practical class/	1	1	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0,25	Working with a kymograph experimental receipt the damped oscillation graphics, attenuation factor calculation and logarithmic decrement damping, and its statistical analysis (laboratory work).
2.11	Definition of the Coefficient of Liquid surface tension by the ring separation method. /Practical class/	1	1	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0,25	Study of the phenomenon of surface tension of liquids using presentations and watching educational films. Experimental determination of the surface tension coefficient of some liquids by the method of ring separation and statistical processing of experimental data (laboratory work.)

2.12	Determination of viscosity coefficient of liquids by Stokes method. /Practical class/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0,25	Study of regularities of processes related to internal friction of liquids through practical determination of the viscosity coefficient of the liquid by Stokes methods. The attention of students to the great importance of the coefficient of dynamic viscosity of biological fluids and its changes in the functioning of the body. Experimental determination of viscosity coefficient of some liquids and statistical processing of experimental data. (laboratory work.)
	Section 3. Physics (part 2)						
3.1	Physical foundations of electrocardiography /Practical class/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0,25	To study the biophysical foundations of the investigations tissues and organs electric fields. To work with an electrocardiograph, make an electrocardiogram, measure and process its parameters: durations and amplitudes of waves, segments and intervals
3.2	Determination the refractor index of liquids using a refractometer /Practical class/	1	2	GK-3 PK – 5 AK – 1	Л1.1 Л2.1 Л2.2 Э1	0,25	To study the phenomenon of the light refraction and to master working with the refractometer IRF-454 B2M, finding the dependence of the refractor indexes for sugar solutions having different concentrations
3.3	Preparation for each practical lesson in physics. /Independed work/	1	10				To perform the IW, it is necessary to refer to the textbook "Medical and biological physics" (L1.2) and draw up a protocol to the laboratory work. In the study of theoretical issues refer to the lecture notes on physics
3.4	Performance of abstract works. /Individual work/	1	10,7				Work on essays provides independent work with educational and scientific literature and contains: title page, plan, text part and references. Reports of abstracts takes place in student groups in the

							form of a presentation, the best works will be presented at the department conference.
3.5	/KpTO/	1	0,3				
3.6	Passing the test with grade	1					

5. FUND OF ASSESSMENT TOOLS

5.1. Control questions and tasks

Questions to test the level of training "KNOW":

- Fundamentals of differential and integral calculus
- Basic concepts of the theory of differential equations
- Basic concepts and theorems of probability theory
- Distribution laws and numerical characteristics of random variables
- Discrete and continuous distribution range. Polygon and histogram
- Point and interval estimations
- Correlation dependence. Correlation coefficient and its properties
- Error theory
- Undamped and damped free mechanical vibrations.
- Attenuation coefficient and logarithmic decrement, the relationship between them. Forced oscillations. Resonance.
- Self-oscillation.
- Doppler effect and its use for biomedical research.
- Characteristics of auditory sensation and their relationship to the physical characteristics of sound.
- Audiometry.
- Physical basis of sound research methods in the clinic.
- Ultrasound and infrasound
- Surface tension coefficient and methods of its determination.
- The phenomenon of wetting and non-wetting.
- Capillary events. Gas embolism.
- Viscous fluid flow. The basic law of viscous flow. Viscosity.
- Laminar flow and turbulent flow of liquids.
- The main indicators of hemodynamics.
- Pulse wave.
- Physical basis of blood pressure measurement.
- Mechanical properties of bone tissue.
- Mechanical properties of blood vessel tissue.
- Bio potentials. Resting potential. Action potential
- Biophysical principles of research of electric fields of tissues and organs
- Dipole equivalent electric generator of heart.
- Electrocardiography vector. Einthoven's Theory.
- Basic electrical properties of body tissues.
- Electrical conductivity of cells and tissues at direct and alternating current
- The effect on the human body of household electric current.
- Biophysics of ventricular fibrillation. Defibrillation.
- Application of electrical current and electromagnetic fields in medicine
- The mechanism of heating dielectrics and electrolytes in the electric UHF field.
- Thermocouple and its application to medicine.
- Sensors and their application in medicine
- Diffraction and interference of light.
- Diffraction grating.
- Refraction of light. Refractometer and work with it.
- The phenomenon of total internal reflection. Fiber optics and its use in medical devices.
- Methods for obtaining polarized light
- The passage of light through the polarizer – analyzer system. Malus law.
- Rotation of the plane of oscillations of polarized light. Optically active substances.
- Study of tissue structure in polarized light.
- X-ray radiation and its application in medicine.
- Ionizing radiation and their biological effect.
- Energy levels of biomolecules and electronic transitions in them.

- Luminescence of biological systems and its types.
- Light absorption
- Transmittance. Optical density of solutions.
- Photo biological processes and spectra of photo biological action.

Tests for the level of training "TO BE ABLE" and "TO MASTER":
- To find derivatives of complex functions, derivatives of higher orders and use them in solving problems of medical and biological content.
- Apply differentials in approximate calculations.
- To find indefinite integrals by direct integration method, substitution method and integration by parts. To calculate definite integrals.
- To find the general and particular solution of differential equations of the first order by the method of separation of variables.
- To make and solve differential equations on the examples of problems of physical, chemical, pharmaceutical and medico-biological content.
- Solve the problem of calculating the probability of random events. Calculate the probability of getting a normally distributed random variable in a given interval. Compute probability in a normal distribution.
- Analyzing discrete and continuous distribution range. Build polygons and histograms.
- Estimate random measurement errors (small samples). To solve problems of applied nature: calculation of the true value of the measured values and their relative and absolute errors at a given confidence level, etc.
- Calculate the coefficient of linear pair correlation. Compose the equation of direct regression for the correlation: the optical density of the solution from the concentration of the substance; the volume of circulating blood from the body weight of the person; the effect of the reagent on the synthesis of the drug, etc.
- Calculate the logarithmic decrement of the attenuation of harmonic oscillations.
- Determine the viscosity coefficient of vegetable and machine oil and compare them.
- Determine the surface tension of water and soapy water and compare them.
- Determine the amplitude characteristics of the teeth (in millivolts) and the characteristics of the duration of the teeth, segments and intervals (in seconds) of the electrocardiogram.
- Plot the heating of the dielectric and electrolyte in the UHF electric field.
- Determine the refractive index of water, alcohol and sugar solutions of different concentrations.
- Determine the wavelength of red, green and purple light (in nanometers).
- Determine the optical density of the riboflavin solution and build its absorption spectrum.
- Determine the temperature of the human body using a thermocouple.
- Determine the percentage of sugar in the water solution.

5.2. Themes of course works (projects)

The discipline does not provide for the writing of the course work and the project

5.3. Evaluation Fund

REFERENCE WORK IN MATHEMATICS. List of tasks (see Annex 1)

EXAMINATION IN PHYSICS. List of questions:
- Undamped free mechanical vibrations.
- Damped free mechanical vibrations.
- Attenuation coefficient and logarithmic decrement, the relationship between them. Forced oscillations. Resonance.
- Self-oscillation
- Nature of sound. Physical characteristics of sound.
- Characteristics of auditory sensation and their relationship to the physical characteristics of sound.
- Weber – Fechner Law.
- Audiometry. Hearing threshold and pain threshold.
- Physical basis of sound research methods in the clinic.
- Ultrasound. The effect of ultrasound on bio tissue, the phenomenon of cavitation.
- Application of ultrasound in medicine.
- Infrasound and its effect on the human body.
- Mechanism of surface tension forces of liquids.
- Surface tension coefficient and methods of its determination.
- Derivation of the formula for determining the surface tension coefficient by the method of detachment of the ring.
- The phenomenon of wetting and non-wetting.
- Capillary events. Gas embolism.
- Viscous fluid flow. The basic law of viscous flow.
- Coefficient of viscosity and methods of its determination. Derivation of the Stokes formula.
- Laminar flow of liquids. Pause Formula.
- Turbulent fluid flow. Reynolds number.
- The main indicators of hemodynamics: a) linear and volumetric blood flow rate; b) blood pressure.

- Hemodynamic resistance (TPVR).
- Pulse wave. The equation of the pulse wave. Moens Formula.
- Physical basis of blood pressure measurement.
- Deformation and its types.
- The main characteristics of deformation. Hooke's law for elastic deformation.
- Mechanical properties of bone tissue.
- The average curve of deformation of compact bone.
- Mechanical properties of blood vessel tissue.
- Derivation of the Lame equation.
- Biopotentials. Types of biopotentials (diffuse, membrane and phase).
- Resting potential. The Goldman Equation.
- Action potential. Hodgkin-Huxley Equation.
- Graph of the action potential of the nerve cell axon.
- Scheme of nerve impulse propagation (depolarization and repolarization). The velocity of the nerve impulse.
- Biophysical principles of research of electric fields of tissues and organs.
- The equivalent electrical generator cells.
- The potential of the electric field generated by the dipole and the dipole.
- The concept of multipole.
- Dipole equivalent electric generator of heart.
- Vector electrocardiography. Einthoven's Theory.
- Electrical conductivity of cells and tissues at constant current.
- Ohm's law for living tissue.
- The electrical conductivity of cells and tissue by the alternating current.
- Impedance. The equivalent electrical circuit of the tissues of the body.
- The effect on the human body of household electric current.
- Biophysics of ventricular fibrillation. Defibrillation.
- Application of direct current in medicine (galvanization and electrophoresis).
- The use of AC in medicine (diameter, darsonvalization, surgical diathermy, Deuteronomy).
- The mechanism of heating dielectrics and electrolytes in the electric UHF field.
- Medical applications of high frequency currents and electromagnetic fields (darsonvalization, surgical diameter, induct meter, UHF – therapy, microwave therapy).
- Contact potential difference.
- The mechanism of thermo-EMF. The formula of thermo-EMF.
- Thermocouple and its application to medicine.
- The calibration of thermocouples and the calibration graph. Determination of body temperature using a thermocouple.
- Sensors and their classification on the principle of action.
- Parametric sensors and the principle of their operation.
- Generator sensors and the principle of their operation.
- Diffraction and interference of light.
- Diffraction grating. The derivation of the diffraction grating.
- Laws of reflection and refraction of light.
- Absolute and relative refractive indices.
- Refraction of light. Refractometer and its purpose.
- The phenomenon of total internal reflection.
- Fiber optics and its use in medical devices.
- Natural and polarized light.
- Polarization of light at reflection and refraction at the boundary of two dielectrics. Brewster's Law.
- Polarization of light at double refraction.
- Nicola prism, the course of the rays in Nicola prism.
- The passage of light through the polarizer – analyzer system. Malus law.
- Rotation of the plane of oscillations of polarized light. Optically active substances.
- Optical scheme of the glucose meter
- Study of tissue structure in polarized light.
- The phenomenon of photoelectric effect. Laws of photoelectric effect.
- The device and the principle of operation of the vacuum and selenium solar cells.
- Nature and basic properties of x-rays.
- The device and the principle of operation of the x-ray tube.
- Brake x-rays and its spectrum.
- Characteristic x-ray radiation and its spectrum.
- Interaction of x-ray radiation with matter (coherent scattering).
- - Interaction of x-ray radiation with the substance (photoelectric effect).
- Interaction of x-ray radiation with the substance (incoherent scattering or Compton effect).

- Application of x-rays in medicine.
- The basic law of radioactive decay.
- The half-life of radioactive nuclei. Activity.
- Penetrating and ionizing ability of radioactive radiation.
- Dosimetry of ionizing radiation (amount of radiation, radiation dose, dose rate, exposure dose).
- Biological dose of ionizing radiation. Protection against ionizing radiation.
- Biological effect of radioactive radiation on the human body.
- Energy levels of biomolecules.
- Electronic transitions in biological molecules (explain the scheme).
- Luminescence of biological systems and its types.
- The absorption of light by bio systems. Booger's law (derivation).
- The law of Lambert-Bouguer-Ber (derivation).
- Transmittance. Optical density of solutions.
- Photo biological processes and spectra of photo biological action.
- Evaluation of measurement errors of physical quantities.

LABORATORY WORK IN PHYSICS. List of laboratory works:
- The study of oscillatory motions using kymograph
- Determination of the surface tension of liquids
- Determination of the viscosity coefficient of the liquid
- Physical basis of electrocardiography
- Determination of the refractive index of liquids using a Refractometer
- Physical bases of low-frequency electrotherapy. Apparatus "Amplipulse"

TEST. List of test questions for laboratory work in physics (see Annex 2)
TEST. List of test questions for the general course (see Annex 3)

ABSTRACT. List of abstract works:
- Physical basis of biomechanics.
- Peculiarities of hemodynamics of the newborn.
- Passive and active transport of substances through the membrane.
- Bio potentials and their classification.
- Physical basis of sound research methods in the clinic.
- Ultrasound is its application in medicine.
- Physical basis of hemodynamics.
- Mechanical and electrical methods of blood circulation.
- Low-frequency and high-frequency currents, their use in medicine.
- Impulse currents and their use in medicine.
- Physical bases of high-frequency methods of video lecture.
- Polarization of biological tissues.
- Impedance of biological tissues.
- Physical basis of electrocardiography.
- Glucose meter and its application in medicine.
- Optical quantum generators and their application in medicine.
- Physical basis of holography and its application in medicine.
- Ultra-weak glow and their use in medicine.
- Radioactivity. The effect of radiation on humans

- Physical basis of dosimetry.
- Physical basis of magnetic therapy.
- Sensors and their application in medicine.
- Optical vision defects and ways to eliminate them.
- Biophysics of color perception.
- Biophysics of hearing.
- Chemical luminescence of biological systems.
- Spectrophotometry of biological fluids.
- Nuclear magnetic resonance and its application in medicine.
- Medical electronic systems.
- Modern methods of osteon synthesis
- Features of blood circulation of the fetus and newborn baby.
- Thermography
- Biologically active points.
- Radiological methods of diagnosis of maxillofacial area
- Physical and mechanical properties of composite materials.

- Pathogenic effect of radioactive radiation on humans.
- Age features of the structure of the eye and its appendages.
- The equivalent electrical circuit of the tissues of the organisms.
- Tensometry and determination of Poisson's ratio of dental materials.
- The kinetics of the curing process of the sealing compositions by an ultrasonic method.
- Application of ultrasound in dentistry.
- Coefficient of linear and volumetric expansion.
- Chemical luminometrics and their importance in medicine.
- Bio mechatronics is an artificial hand.
- Nanotechnology in medicine
- Nanotechnology in Oncology
- Nanotechnology in dentistry
- Radiation situation in Kyrgyzstan.
- Shape memory effect.
- Physiotherapy in Pediatrics

5.4. A list of the types of assessment tools

Control work in mathematics
Laboratory work
Test
Abstract

SCALE GRADING OF THE CONTROL WORK IN MATHEMATICS (midterm control) (see Annex 4)
INSTRUCTIONS for the assessment in %:
- Solution of the probability problem-0-25%;
- Solving the problem of calculating the numerical characteristics of a random variable and determining the probability that it will take a value less than a fixed number -0-25%;
- Solving the problem of mathematical processing of biomedical data. -0-25%
- Solution to the problem of calculating the correlation coefficient-0-25%
All control work is estimated at 0-100%

SCALE GRADING OF CONTROL WORK IN PHYSICS (interim control) (see Annex 7)
INSTRUCTIONS for the assessment in %:
- The answer to the first task -0-35%
- Answer to the second task -0-35%
- Confidence interval for the arithmetic mean is calculated - 0-30%
All control work is estimated at 0-100%

SCALE OF EVALUATION of laboratory work in physics (midterm control) (see Annex 5)
INSTRUCTIONS for the assessment in %:
- Oral interview - 0-30 %
- Test (20 questions, each correct answer is estimated at 1 %) - 0-20 %
- Preparation of reports (protocols) of laboratory work -0-50 %
The report on laboratory work is estimated at 0-100%

SCALE OF EVALUATION of abstract work (midterm control)
INSTRUCTIONS for the assessment in %:
The abstract reveals the content of the problem, its relevance and practical significance - 0-40 %
Submitted on time, taking into account all requirements for the content and design of the work - 0-30 %
The student can justify their judgments, owns the conceptual apparatus of the topic, the defense of the abstract was held in the group
in the form of a presentation – 0-30 %
The abstract is estimated at 0-100%

SCALE OF ASSESSMENT of an ORAL test (interim control – "to KNOW") %.
The following criteria are taken into account when assessing the oral responses to the test of the level of training “to KNOW”:
General physical laws, processes occurring in the body;
the basic physical properties of biological tissues;
characteristics of external factors acting on the body;
purpose and characteristics of medical devices;
fundamentals of differential and integral calculus;
theory of first order differential equations;
fundamentals of statistical methods;

- the degree of disclosure of the content of the material 0-50%
- presentation of the material (literacy, accuracy of terminology and symbols, logical sequence of presentation 0-25%
- formation and stability of the skills used in the answer 0-25%
The oral survey is estimated at 0-100%

SCALE OF ASSESSMENT OF ANALYTICAL AND PRACTICAL TASKS
interim control – a "TO BE ABLE" and "OWN")
The following criteria are taken into account when assessing the answers to the test of the level of training "TO BE ABLE" and "OWN":
make physical measurements and statistically process the results of measurements and draw appropriate conclusions;
methods of registration of protocols of laboratory works;
methods of work on laboratory equipment;
the method of finding derivatives and integrals;
methods of modeling medical and biological processes using the theory of differential equations;
- the degree of knowledge of the mathematical apparatus in solving problems 0-30%
- the degree of knowledge of the physical experiment and the methods of statistical processing of experimental data 0-30%
- preparation of reports (protocols) of laboratory works 0-40%

6. EDUCATIONAL-METHODICAL AND INFORMATION SUPPORT OF DISCIPLINE (MODULE)			
6.1. Recommended literature			
6.1.1. Main literature			
	Authors, composers	**Title**	**Publisher, year**
L1.1	Irving P. Herman	Physics of the Human Body	Springer, 2006
L1.2	A.Gelig et all	Mathematics for medical students	SPbU, 2005
L1.3	Sorokin A., etc.	Higher Mathematics. Textbook	KRSU, 2013
L1.4	Sologubova T., etc.	Medical and Biological Physics. Textbook.	KRSU, 2010
6.1.2. Additional literature			
L2.1	Лещенко В.Г., Ильич Г.К	Медицинская и биологическая физика: Учебное пособие	Москва "ИНФРА-М" 2012
L2.2	Ремизов А.Н., Максина А.Г., Потапенко А.Я	Медицинская и биологическая физика: Учебник	М.: Дрофа 2008
L2.3	Павлушков И.В.	Основы высшей математики и математической статистики (имеется на кафедре)	ГЭОТАР-Медиа 2012
L2.4	Самойлов О.В.	Медицинская биофизика	Изд-во СпецЛит 2013
6.2. List of resources of information and telecommunication network "Internet"			
E1	Medical literature (mathematics)		1) https://pressbooks.library.torontomu.ca/ohsmath/ 2) https://vetpocket.co/products/medical-mathematics-for-veterinary-professionals
E2	Medical literature (physics)		3) https://www.amazon.com/Course-Medical-Biological-Physics/dp/3659969117 4) https://bookauthority.org/books/beginner-biophysics-books
6.3. List of information and educational technologies			
6.3.1 Competence-oriented educational technologies			
6.3.1.1	To organize the study of the discipline, traditional educational technologies are used, focused on the communication of knowledge and methods of action transferred to students in a ready form. Lecture material is provided to students using multimedia equipment. Traditional educational technologies include: explanatory and illustrative lectures; and explanatory practical classes.		

6.3.1.2	Innovative educational technologies, classes in an interactive form, which form a system of thinking and the ability to generate ideas in solving various situational problems. Innovative educational technologies include two reports, the control of which is made in the form of independent work in the classroom.
6.3.1.3	Information educational technologies – independent use of computer equipment and Internet resources for practical tasks and independent work.
6.3.2 List of information reference systems and software	
6.3.2.1	1. Mathematics in Medical Science https://www.google.com/search?q=medical+mathematics+textbooks&oq=&aqs=chrome.3.69i59i450l8.448480j0j7&sourceid=chrome&ie=UTF-8
6.3.2.2	**2.** Scientific electronic library - http://elibrary.ru/defaultx.asp
6.3.2.3	3. The website of the library of KRSU (http://lib.krsu.edu.kg)

7. LOGISTICS AND TECHNICAL SUPPORT OF THE DISCIPLINE (MODULE)	
7.1	Theoretical classes are held in lecture halls with 150 seats.
7.2	Practical classes are held in three classrooms with 14 seats each
7.3	Multimedia complex (laptop, projector).
7.4	Multimedia and slate.
7.5	Laboratory equipment: electrocardiograph machine, UHF-therapy, refractometer, kymograph, thermocouple, diffraction grating, saccharimeter, sound generator, an inductive sensor, a sound level meter, device for determination of surface tension by the method of separation ring, the equipment to determine the coefficient of viscosity of liquids by the method of Stokes light meter

8. METHODOLOGICAL INSTRUCTIONS FOR STUDENTS ON MASTERING THE DISCIPLINE (MODULE)

Technological map of the discipline is in APPENDIX 6

Guidelines for independent extracurricular work of students to study the theoretical foundations of the discipline "physics, mathematics".

The study of the theoretical part of the discipline is designed to not only deepen and consolidate the knowledge gained in the classroom, but also to promote the development of students' creative skills, initiative and organization of their free time. Independent work of the student in the study of the discipline includes:
- reading the recommended literature and mastering the theoretical material of the discipline;
- familiarity with Internet sources; - preparation for various forms of control (control work, test);
- work on the creation of a protocol for laboratory work.

Planning the time required to study the discipline, students are better to carry out the entire semester, while providing for regular repetition of the material.
The material outlined in the lectures should be regularly studied and supplemented with information from other sources of literature presented not only in the discipline program, but also in periodicals.
When studying the discipline it is necessary for each topic to read the recommended literature and make a brief summary of the main provisions, terms, information that require memorization and are fundamental to this topic, for the development of subsequent topics of the course. To expand knowledge of the discipline, it is recommended to use Internet resources; conduct searches in various systems and use the materials of sites recommended by the teacher.

CONTROL WORK In preparation for the decision of the control work is necessary:
- to work out the relevant pages of textbooks;
- use lecture notes or notes from practical material;
- solve as much as possible the problems at home on relevant topics.

LABORATORY WORK In preparation for the laboratory work it is necessary to:
- to work out the theoretical material from the textbooks;
- conduct a test of self-knowledge;
- prepare a protocol for laboratory work;
- perform laboratory work and submit a report including mathematical processing of experimental data and their analysis

TEST
In preparation for the tests, it is necessary to work out the lecture material and the relevant pages of textbooks (it is also desirable to
read additional literature); solve all the necessary practical tasks; perform all the necessary laboratory work

ESSAY

Students do work on the essay individually, on their own with the aim of consolidating and deepening of theoretical knowledge. The topic of the abstract and the proposed work plan is discussed with the teacher, and then the student independently selects, analyzes and structures the material. The approximate volume of the abstract – 10-15 sheets of printed text, welcome the use of diagrams, drawings, tables, complementing the main material. The work should contain the purpose, objectives of the study, and generalized conclusions on the problem. In the structure of the abstract, there is a title page, designed according to the requirements, table of contents, introduction, main part, final, list of used literature and Internet resources. The abstract should be submitted to the teacher for review within the specified time, after correcting the material comments (if any), the student can proceed to presentation at the appointed time.

A sample of the title page of the essay is presented in Annex 8

ANNEX 1

SCALE FOR EVALUATION OF PRACTICAL (LABORATORY) WORKS (current/terminal control)

• 85-100% - A student demonstrates complete understanding of the problem. All requirements for the assignment are met.
• 70-84% - A student demonstrates significant understanding of the problem. All requirements for the assignment have been met.
• 60-69% - A student demonstrates a partial understanding of the problem. Most of the requirements for the task are met.
• 31-60% - A student demonstrates little understanding of the problem. Many requirements for the assignment were not met.
• 0-30% - A student demonstrates a lack of understanding of the problem and no attempt has even been made to solve the problem.

SCALE FOR ASSESSING ANSWERS TO CONTROL QUESTIONS (current control)

• 85-100% - A student demonstrates complete understanding of the problem. All tasks completed.
• 70-84% - A student demonstrates significant understanding of the problem. All tasks are completed, but contain some inaccuracies.
• 60-69% - A student demonstrates a partial understanding of the problem. Most of the requirements for the assignment have been met.
• 31-60% - A student demonstrates little understanding of the problem. Many requirements for the assignment were not met.
• 0-30% - A student demonstrates a lack of understanding of the problem or no answer, and there was not even an attempt to solve the problem.

WRITTEN SURVEY SCALE (intermediate control - "KNOW")

• A mark (14-16 - points) evaluates the answer, which shows a solid knowledge of the theoretical foundations of the discipline, understanding and correct use of terminology, correct answers to 75-100% of questions
• A mark (11-13 points) evaluates the answer, which shows knowledge of the theoretical foundations of the discipline, but incomplete understanding and not always correct use of terminology, correct answers were given to 50-74% of questions, a number of inaccuracies were made in the answers.
• A mark (8-10 points) evaluates the answer, indicating familiarity with some of the theoretical foundations of the discipline. Correct answers were given to 25-49% of questions, inaccuracies and mistakes were made.
• A mark (5-7 points) evaluates the answer, revealing ignorance of the theoretical foundations of the discipline. There is a lack of logic and consistency in the answer. Less than 25% correct answers. Serious errors were made in the content of the answer.
• A mark (0-4 points) evaluates the answer, in which the student demonstrates a lack of understanding of the questions, or no answer.

SCALE OF EVALUATION OF THE SUMMARY

• 85-100% - the student has deeply and comprehensively mastered the problem; - confidently, logically, consistently and competently sets it out; - relying on the knowledge of the main and additional literature, closely links the acquired scientific provisions with practical activities; - skillfully substantiates and argues the ideas put forward by him; - draws conclusions and generalizations; - fluent in concepts
• 70-84% - the student has firmly mastered the topic, correctly and to the point sets it out, relying on knowledge of the main literature; - does not allow significant inaccuracies; - links acquired knowledge with practical activities; - argues scientific provisions; - draws conclusions and generalizations; - owns a system of basic concepts
• 60-69% - the topic is not disclosed clearly enough and fully, that is, the student has mastered the problem, essentially sets it out, relying on knowledge of only the main literature; - allows minor errors and inaccuracies; - experiences difficulties in the practical application of knowledge; - weakly argues scientific positions; - finds it difficult to formulate conclusions and generalizations; - partially owns the system of concepts
• 31-60% - the student demonstrates little understanding of the problem. Many job requirements not met
• 0-30% - the student did not master a significant part of the problem; - allows significant errors and inaccuracies when considering it; - experiencing difficulties in the practical application of knowledge; - cannot argue scientific positions; - does not formulate conclusions and generalizations; - does not own the conceptual apparatus

ASSESSMENT SCALE FOR PRACTICAL ASSIGNMENTS AND SIW
(intermediate control - "TO BE ABLE AND TO MASTER")

• A mark (8-9 points) evaluates the answer, in which the student correctly solves individual problems in mathematics and medical biophysics. Demonstrates a thorough understanding of the problem. All job requirements have been met.
• A mark (6-7 points) evaluates the answer, in which the student mostly correctly solves individual problems in mathematics and medical biophysics. Demonstrates significant understanding of the problem. Most of the job requirements have been met.
• A mark (4-5 points) evaluates the answer, in which the student solves individual problems in mathematics and medical biophysics incorrectly, demonstrates the inability to correctly solve the problem from the individual task. Demonstrates partial or little understanding of the problem. Many of the requirements for the assignment are not met.
• A mark (0 -3 points) marks the answer, in which the student demonstrates a lack of understanding of the problem or no answer, and there was not even an attempt to solve the problems.

APPENDIX 2

Technological map of the discipline "Medical biophysics"
Course 1, Semester 2, Number of credits - 2, Reporting - credit with assessment

Name of discipline modules according to the WP (according to the number of credits in the semester minus on CW (CP))	Control	Control form	Credit minimum	Credit maximum	Control schedule (week of the semester)
Module 1					
Section 1. Matemathics	Current control	Activity, attendances; Independent work	4 5	8 9	8
	Frontier control	Control work №1 on Math	12	16	
Module 2					
Section 2. Physics	Current control	Activity, attendances; Independent work	4 5	8 9	17
	Frontier control	Lab reports, tests Essay	6 4	10 9	
TOTAL in semester			**40**	**70**	18
Intermediate control (credit with assessment)			**20**	**30**	
Semester rating by discipline			**60**	**100**	

APPENDIX 3

Essay title page template

MINISTRY OF EDUCATION AND SCIENCE OF THE KYRGYZ REPUBLIC

KYRGYZ-RUSSIAN SLAVIC UNIVERSITY

MEDICAL FACULTY

Department of Physics, Medical Informatics and Biology

Essay

SUBJECT:

Student: F.I.O. student, specialty
, group
Supervisor: Full name, academic degree and title of teacher.

Bishkek 2025