

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
EDUCATIONAL INSTITUTION
BELARUSIAN STATE MEDICAL UNIVERSITY

Контрольный
экземпляр



APPROVED

by First Vice-Rector, Professor

I.N.Moroz

27.06.2023

Reg. # UD-0911-03-02/2324/edu.

MEDICAL AND BIOLOGICAL PHYSICS

Curriculum of educational institution
in the educational discipline for the specialty:

7-07-0911-03 «Dentistry»

Curriculum is based on the educational program in the specialty 7-07-0911-03 «Dentistry», approved 27.06.2023, registration # УД-0911-03-02/2324/уч.; on the educational plan in the specialty 7-07-0911-03 «Dentistry», approved 17.05.2023, registration # 7-07-0911-03/2324.

COMPILERS:

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RECOMMENDED FOR APPROVAL:

by the Medical and Biological Physics Department of the Educational Institution «Belarusian State Medical University»
(protocol # 10 of 18.05.2023);

by the Scientific Methodical Council of the Educational Institution «Belarusian State Medical University»
(protocol # 6 of 27.06.2023)

EXPLANATORY NOTE

«Medical and Biological Physics» is the educational discipline of Natural Science Module containing systematized scientific knowledge concerning the physical phenomena determining the sense of many vital processes, including those occurring at the cellular and molecular levels, it also analyzes the principles of modern methods of diagnosis and treatment.

The aim of the discipline «Medical and Biological Physics» is the formation of basic professional competency for the application of diagnostic and treatment methods in dental practice.

The objectives of the discipline «Medical and Biological Physics» are to form students' scientific knowledge about:

- the physical and chemical processes occurring in the living organism;
- mechanical and physical properties of dental materials;
- mechanical and physical properties of biological tissues;
- physical methods of modern diagnosis and therapy applied in dentistry;
- properties of physical fields effecting the biological objects;
- fundamentals of mathematical processing of experimental data;
- skills and abilities necessary for:
- use of diagnostic and therapeutic equipment;
- interpretation of the results of laboratory and instrumental research methods;
- safe use of medical equipment.

The knowledge, skills, and abilities acquired during the study of the academic discipline «Medical and Biological Physics» are necessary for successful mastering of the following academic disciplines: «Human Anatomy», «Normal Physiology», «Radiation Medicine and Ecology», «Radiodiagnosis and Radiotherapy», «Materials Science and Fundamentals of Manufacturing Dentures».

Studying the educational discipline «Medical and Biological Physics» should ensure the formation of the following students' basic professional competency:

BPC. Apply the basic biophysical laws and knowledge concerning the general principles of medical equipment functioning for solving the problems of professional activity.

As a result of studying the discipline «Medical and Biological Physics» the student should

know:

- basic laws of physics and biophysics underlying the processes occurring in the human organism, rheological properties of biological tissues and fluids;
- characteristics of physical factors (medical, climatic, industrial) effecting the human organism and biophysical mechanisms of such effects;
- purpose, operating basis and practical use of medical equipment, safety requirements while working with it;
- principles of mathematical methods of experimental data processing;
- physical basis of the methods applied for diagnosis, environmental monitoring and effect on the human organism for therapeutic and prophylactic purposes;
- novel physical advantages and prospects for their use in professional activity;
- physical and mechanical properties of tooth tissues and dental materials.

be able to:

use the main measuring devices;
 work with electronic medical equipment;
 apply modern informational technologies for processing and representation of measurement results.

master:

the methods to determine different physical characteristics of biological objects;

the methods to determine mechanical and physical characteristics of dental materials;

practical skills of application of diagnostic and therapeutic equipment.

Total number of hours for the study of the discipline is 124 academic hours. Classroom hours according to the types of studies: lectures – 10 hours (including 3 hours for supervised student independent work), laboratory classes – 45 hours, practical classes – 27 hours, student independent work (self-study) – 42 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of an examination (2 semester).

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Number of academic hours of classes						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures	supervised student independent work	laboratory and practical classes		
7-07-0911-03 «Dentistry»	1	60	40	4	1	36	20	-
	2	64	42	6	2	36	22	examination

THEMATIC PLAN

Section (topic) name	Number of class hours		
	lectures	laboratory	practical
1. Mathematical description of medical and biological processes and medical data processing	-	-	4
1.1. Investigation of functional dependencies	-	-	2
1.2. Principles of the error theory	-	-	2
2. Fundamentals of biomechanics with aspects of materials science in dentistry	2	6	4
2.1. Physical basis of materials mechanics		2	2
2.2. Mechanical and thermal properties of dental materials and tooth tissues	2	4	-
2.3. Principles of maxillofacial system biomechanics		-	2
3. Bioacoustics	-	2	4
3.1. Origin and classification of acoustic waves	-	-	2
3.2. Physical and physiological characteristics of sound waves. Sound methods in medicine	-	2	-
3.3. Ultrasound and its application in medicine	-	-	2
4. Physical basis of biorheology, hydrodynamics and hemodynamics	2	4	8
4.1. The main concepts and laws governing ideal and viscous fluid flow. Viscosimetry		2	4
4.2. Physical basis of hemodynamics (hemorheology)	2	-	2
4.3. Principles of surface phenomena physics		2	-
4.4. Adhesion. Role of adhesion in dentistry		-	2
5. Physical processes in biological membranes	-	-	4
5.1. Physical properties of biological membranes. Transport of substances across biological membranes	-	-	2
5.2. The membrane cell potentials	-	-	2
6. Application of electric current, electric and magnetic fields in medicine	2	15	-
6.1. Physical basis of tissue and organ electrography	2	2	-
6.2. Electrostimulation of tissues and organs		2	-

Section (topic) name	Number of class hours		
	lectures	laboratory	practical
6.3. Obtaining and recording medical data, characteristics of electromedical equipment		4	-
6.4. Electric and magnetic properties of human body tissues. Physical basis of magnetic resonance imaging		4	-
6.5. Effect of electric current, electric and magnetic fields on human organism		3	-
7. Electromagnetic radiation and its application in medicine	4	18	3
7.1. Electromagnetic waves, its properties. Light polarization, polarization methods in biology and medicine. The light absorption and its laws		4	-
7.2. Refractometry. Optical microscopy		4	-
7.3. Light reflection, absorption and scattering processes in skin, tooth tissues and dental materials	2	2	-
7.4. Thermal radiation of bodies. Clinical thermography. Heat transfer of the human body		2	-
7.5. Light emission and absorption by atoms and molecules. Luminescence		4	-
7.6. Stimulated emission. Lasers and their medical applications		2	-
7.7. Bremsstrahlung X-radiation, its origin and generation	2	-	1
7.8. X-radiation interaction mechanisms with matter. X-radiation application in medicine		-	2
Total hours	10	45	27

CONTENT OF THE EDUCATIONAL MATERIAL

1. Mathematical description of medical and biological processes and medical data processing

1.1. Investigation of functional dependencies

Constants and variables. Function definition. Elementary functions and their graphs. Derivative as a measure of the process speed. Gradients.

1.2. Principles of the error theory

Direct and indirect measurements. Evaluation of the accuracy of the experimentally obtained result. Confidence level and confidence interval, the relative measurement error.

2. Fundamentals of biomechanics with aspects of materials science in dentistry

2.1. Physical basis of materials mechanics

Static and dynamic loads. The main mechanical properties of materials applied in dentistry: strength, elasticity, plasticity, brittleness, hardness, impact strength, fatigue of materials. Main types of solid body deformation. Mechanical stress. Hooke's law for the case of axial tension (compression). Young's modulus, shear modulus, Poisson coefficient, relationship between them. Stress-strain curve. Determination of the elasticity modulus (Young's modulus) by the bending beam method. The strength value calculation under the tension and compression.

The Brinell, Vickers, and Knoop hardness tests. The systemic and nonsystemic units for hardness. The Mohs' scale.

Impact strength, its relationship with the brittleness of material.

2.2. Mechanical and thermal properties of dental materials and tooth tissues

The temperature of melting and boiling, the specific heat, the coefficient of thermal conductivity and thermal diffusivity, the linear and volumetric thermal expansion coefficients, the procedure of their determination.

2.3. Principles of maxillofacial system biomechanics

Forces, moments of forces, stress and strain in the maxillofacial region of a human being. The skull as an example of the first-class lever. The jaw as an example of the second-class lever. Mechanical properties of compact and spongy bone tissue, and skin. Overturning moment when the force acts on a tooth at an angle to its vertical axis.

3. Bioacoustics

3.1. Origin and classification of acoustic waves

Origin of acoustic waves. Sound, infrasound and ultrasound. Speed of acoustic waves in different media (gas, liquid, solid). Classification of sounds. The reflection and the absorption of acoustic waves. Acoustic impedance. The reflection and the absorption coefficients of acoustic waves.

3.2. Physical and physiological characteristics of sound waves. Sound methods in medicine

Physical and physiological characteristics of sound. The intensity level and loudness, the relationship between them. Audition diagram. The Weber-Fechner's Law. Audiometry.

3.3. Ultrasound and its application in medicine

The generation and registration of ultrasound. Characteristic properties of ultrasound determining its application in medicine. Principles of A-, B- и M-ultrasound diagnostic methods. Doppler ultrasonography, ultrasound osteometry (echoosteometry).

4. Physical basis of biorheology, hydrodynamics and hemodynamics

4.1. The main concepts and laws governing ideal and viscous fluid flow. Viscosimetry

Linear flow velocity, the volume flow rate of liquid and relationship between them, units. Equation of continuity of flow. Ideal fluid, Bernoulli's equation.

Newton's formula for frictional force in fluid. Viscosity of fluid. Newtonian and non-Newtonian fluid. Factors effecting viscosity of blood. Viscosity of blood at normal state and at various pathologies. Poiseuille's law. Methods of viscosity measurements (Ostwald and rotational viscometers). Laminar and turbulent flow. Reynolds number.

4.2. Physical basis of hemodynamics (hemorheology)

Rheological properties of dental materials, blood and plasma. Distribution of linear velocity of the blood flow and pressure drop in different segments of circulatory system. Pulse wave. The work and power of the heart.

4.3. Principles of surface phenomena physics

Surface tension. Wetting. Pressure under the curved surface of a fluid. Laplace formula. Capillary phenomena. The origin of gas embolism. Physical laws determining the inspiration and expiration mechanisms. Methods of the liquid surface tension determination.

4.4. Adhesion. Role of adhesion in dentistry

Physical basis of adhesion. Factors effecting the strength of the adhesive joint. Application of adhesive systems in restorative dentistry.

5. Physical processes in biological membranes

5.1. Physical properties of biological membranes. Transport of substances across biological membranes

Passive transport of substances across biological membranes and its types. Mathematical description of passive transport. Active transport of ions.

5.2. The membrane cell potentials

The resting membrane potentials. Action potential generation mechanism. Refractoriness.

Local currents. The specific features of the action potential propagation along the unmyelinated and myelinated nerve fiber.

6. Application of electric current, electric and magnetic fields in medicine

6.1. Physical basis of tissue and organ electrography

The main characteristics of the electric field. The electrostatic and current dipole. Electrocardiography. Einthoven theory. Current dipole is an equivalent electric heart generator. Electrocardiogram formation, its shape. Electromyography, its application in medicine.

6.2. Electrostimulation of tissues and organs

Electric pulses characteristics and their physiological meaning. Du Bois-Reymond law. Weiss-Lapicque equation. Principles of chronaxiometry. Low frequency electrodiagnosis and electrotherapy in dentistry.

6.3. Obtaining and recording medical data, characteristics of electromedical equipment

Electrodes, sensors, amplifiers and registration devices, their types and characteristics. The electrocardiograph block scheme. Recording and processing of electrocardiograms.

Active and passive sensors of temperature, their calibration and application in dentistry.

Frequency and amplitude characteristics of the voltage amplifier, amplifier bandwidth and dynamic range. The working principle of the differential amplifier.

6.4. Electric and magnetic properties of human body tissues. Physical basis of magnetic resonance imaging

The peculiarities of the biological tissue electroconductivity in the case of direct and alternative current. Treatment methods based on the application of direct current: galvanization, electrophoresis. An equivalent electric circuit of the living tissue conductivity. Electrical impedance of tissue and its dependence on the alternating current frequency. The estimation of tissue viability. Reography (plethysmography) as a diagnostic method in dentistry. The peculiarities of magnetic properties of living tissues. Physical basis of magnetic resonance imaging.

6.5. Effect of electric current, electric and magnetic fields on human organism

High frequency current effects. Thermal and nonthermal effects. Diathermy, electrosurgery, inductothermy, ultra high frequency therapy, microwave diathermy, darsonvalization. Purpose of the therapeutic circuit application in ultra high frequency therapy.

7. Electromagnetic radiation and its application in medicine

7.1. Electromagnetic waves, its properties. Light polarization, polarization methods in biology and medicine. The light absorption and its laws

General properties of electromagnetic waves. Natural and polarized light. The methods to obtain linearly polarized light. Malus law. Optically active substances. Polarization plane rotation. Determination of the optically active substance concentration by polarimeter. Spectropolarimetry. Photoelasticity in dentistry.

Processes of the light interaction with substance. The light absorption phenomenon and its laws (Bouguer and Beer-Lambert laws). Transmittance and optical density. Basic working principles of a photoelectric colorimeter and other spectral instruments. The absorption spectrum of blood.

7.2. Refractometry. Optical microscopy

Determination of the solution refraction index using refractometer. Determination of the solution concentration by the refraction index. Total internal reflection phenomenon. Fiber optics and its application in medicine.

Ray tracing in optical microscope, magnification and resolution limit of a microscope. Basic principles of electron and atomic force microscopy. Determination of the microscopic object sizes using an optical microscope.

7.3. Light reflection, absorption and scattering processes in skin, tooth tissues and dental materials

Specular and diffuse light reflection. Light scattering: Rayleigh scattering, Mie scattering. The specific features of light interaction with skin and tooth tissues. Optical properties of modern composites for creation esthetic restorations in dentistry.

4. Thermal radiation of bodies. Clinical thermography. Heat transfer of the human body

Thermal radiation characteristics and laws. The radiant intensity, spectral emissivity and absorptivity. Blackbody, grey body, other bodies. Kirchhoff, Stefan-Boltzmann and Wien laws. Planck formula. Recording of the temperature distribution

on the human body surface using thermal imaging. Diagnostic analysis of thermograms. Heat exchange processes between the human body and the environment.

7.5. Light emission and absorption by atoms and molecules. Luminescence

Energetic states of atomic systems. Luminescence, its classification, characteristics and laws. Application of luminescent methods in medicine and particularly in dentistry.

7.6. Stimulated emission. Lasers and their medical applications

Principle of laser operation. Laser classification. Laser radiation properties. Laser Doppler anemometry (velocimetry), speckle interferometry, holography. Laser therapy and surgery in dentistry.

7.7. Bremsstrahlung X-radiation, its origin and generation

The generation of «Bremsstrahlung» X-radiation, its spectral characteristics. Control of the hardness and the energy flux of Bremsstrahlung X-radiation.

7.8. X-radiation interaction mechanisms with matter. X-radiation application in medicine

Coherent scattering, photoelectric effect, Compton effect. X-radiation attenuation law. The half-value layer. Protection on X-radiation.

X-ray diagnosis and therapy. Principles of X-ray computed tomography. Visiographs in modern dentistry.

EDUCATIONAL DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	number of hours				Self-studies	Form of control
		lectures	supervised student work	laboratory	practical		
	Semester 1						
1	Mathematical description of medical and biological processes and medical data processing	-	-	-	4	3	
1.1	Investigation of functional dependencies	-	-	-	2	1	interview
1.2	Principles of the error theory	-	-	-	2	2	interview
2	Fundamentals of biomechanics with aspects of materials science in dentistry	2	0,5	6	4	4	
2.1	Physical basis of materials mechanics	-	-	-	2	1	interview
	Fundamentals of biomechanics with aspects of materials science in dentistry	2	0,5	-	-	-	
	Determination of the elasticity modulus (Young's modulus) by the bending beam method	-	-	2	-	-	interview, report
	L.W. Determination of the elasticity modulus of materials by the bending beam method	-	-	-	-	-	
2.2	Mechanical and thermal properties of dental materials and tooth tissues	-	-	4	-	-	
	Hardness determination by Brinell, Vickers, and Knoop hardness tests. L.W. Determination of hardness of materials by Vickers test	-	-	2	-	1	interview, report

	Thermal properties of dental materials and tooth tissues, their characteristics. L.W. Determination of liner coefficient of thermal expansion	-	-	2	-	1	interview, essay
2.3	Principles of maxillofacial system biomechanics	-	-	-	2	1	interview, report, essay
3	Bioacoustics	-	-	2	4	4	-
3.1	Origin and classification of acoustic waves	-	-	-	2	1	interview
3.2	Physical and physiological characteristics of sound waves. Sound methods in medicine. L.W. Measurement of the ear spectral characteristic at the threshold of hearing	-	-	2	-	1	interview, report
3.3	Ultrasound and its application in medicine	-	-	-	2	2	interview, essay, test
4	Physical basis of biorheology, hydrodynamics and hemodynamics	2	0,5	4	8	6	
4.1.	The main concepts and laws governing ideal and viscous fluid flow. Viscosimetry Equation of continuity of flow. Ideal fluid, Bernoulli's equation.	-	-	2	4		
	The main concepts and laws governing viscous fluid flow.	-	-	-	2	-	interview
	Viscosity of fluid and methods of viscosity measurements. L.W. Determination of viscosity of fluid by Ostwald viscometer	-	-	-	2	1	interview
4.2	Physical basis of hemodynamics (hemorheology) Physical basis of hydrodynamics and hemodynamics	-	-	-	2	-	interview, test
4.3.	Principles of surface phenomena physics. L.W. Determination of the surface tension of liquid by maximum bubble pressure method	2	0,5	-	-	-	
		-	-	2	-	1	interview, report

4.4	Adhesion. Role of adhesion in dentistry.	-	-	-	-	2	2	interview, essay, electronic test	
5	Physical processes in biological membranes	-	-	-	-	4	3		
5.1	Physical properties of biological membranes. Transport of substances across biological membranes	-	-	-	-	2	1	interview, test	
5.2	The membrane cell potentials	-	-	-	-	2	2	interview, electronic test	
Total hours		4	1	36	20				
2 Semester									
6	Application of electric current, electric and magnetic fields in medicine	2	0,5	15	-	8			
6.1.	Physical basis of tissue and organ electrography. L.W. Recording and treatment of electrocardiogram	-	-	2	-	1		interview, report	
6.2.	Electrostimulation of tissues and organs L.W. Determination of the parameters of rectangular pulses of voltage	-	-	2	-	1		interview, report	
6.3	Obtaining and recording medical data, characteristics of electromedical equipment	-	-	4	-	-			
	Obtaining and recording medical data, characteristics of electromedical equipment. Sensors. L.W. Calibration of electrical temperature sensors	-	-	2	-	1		interview, report, essay	
	Amplifiers of biopotentials. L.W. Determination of frequency and amplitude characteristics of amplifier	-	-	2	-	-		interview, report	
6.4	Electric and magnetic properties of human body tissues. Physical basis of magnetic resonance imaging	-	-	4	-	-			
	Electric and magnetic phenomena in organism, electric effects and methods of investigation	2	0,5	-	-	-			
	Electric and magnetic properties of human body tissues. Physical basis of magnetic resonance imaging. L.W. Investigation of principle of working of the galvanization apparatus	-	-	2	-	2		interview, report, essay	

	Electrical impedance of tissue and its dependence on the alternating current frequency. The estimation of tissue viability L.W. Investigation of the dependence of biological tissue impedance on alternating current frequency	-	-	2	-	1	interview, report, essay
6.5	Effect of electric current, electric and magnetic fields on human organism L.W. Investigation of high frequency electric current and fields on human organism	-	-	3	-	2	interview, report
7	Electromagnetic radiation and its application in medicine	4	1,5	18	3	14	
7.1.	Electromagnetic waves, its properties. Light polarization, polarization methods in biology and medicine. The light absorption and its laws Electromagnetic waves, its properties. Light polarization. L.W. Determination of the optically active substance concentration by polarimeter	-	-	4	-	-	
	The light absorption phenomenon and its laws. L.W. Determination of the solution concentration by photoelectric colorimeter	-	-	2	-	1	interview, report
7.2	Refractometry. Optical microscopy Refractometry L.W. Determination of the solution concentration by the refractometer Optical microscopy L.W. Measurement of the small object sizes using an optical microscope	-	-	4	-	-	
		-	-	2	-	1	interview, report
		-	-	2	-	1	interview, report

7.3	Light reflection, absorption and scattering processes in skin, tooth tissues and dental materials L. W. Investigation of optical characteristics of biological tissues	-	-	2	-	2	-	2	interview, report, assay
	Optical methods of investigation and the interaction of the optical region radiation with biological objects	2	0,5	-	-	-	-	-	
7.4	Thermal radiation of bodies. Clinical thermography. Heat transfer of the human body L. W. Investigation of principle of working of thermal imager	-	-	2	-	2	-	1	interview, report
7.5	Light emission and absorption by atoms and molecules. Luminescence Light emission and absorption by atoms and molecules. L. W. Investigation of the absorption spectrum of blood	-	-	-	-	4	-	-	
	Luminescence, application of luminescent methods in medicine. L. W. Investigation of the spectra of fluorescent markers	-	-	2	-	2	-	1	interview, report
7.6	Stimulated emission. Lasers and their medical applications. L. W. Determination of the laser radiation wavelength with the use of diffraction grating	-	-	2	-	2	-	2	interview, report, assay
7.7.	X-radiation, its application in medicine	2	1	-	-	-	-	-	
7.8.	Bremsstrahlung X-radiation, its origin and generation X-radiation interaction mechanisms with matter. X-radiation application in medicine	-	-	-	-	-	3	3	interview, electronic test, examination
	Total hours	6	2	36	2	36	22	22	

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic (relevant):

1. Remizov, A. N. Medical and biological physics : textbook. / A. N. Remizov. – Moscow : Geotar-Media, 2021. – 568 p.

Additional:

2. Medical and biological physics : учеб.-метод. пособие / Л. В. Кухаренко и др. – Minsk : BSMU, 2016. – 260 p.
3. Medical and biological physics. Lecture course / L. V. Kukharenko, M. V. Goltsev – Minsk : BSMU, 2018. – 132 p.
4. Nikonenko, N. A., Insarova, N. I. Physical properties of dental materials, tissues of tooth and skin. Principles of rheology. Physical basis of adhesion / N. A. Nikonenko, N. I. Insarova – Minsk : BSMU, 2015. – 52 c.
5. Nikonenko, N. A. Optical properties of skin, tooth tissues and dental materials / N. A. Nikonenko – Minsk : BSMU, 2015. – 35 c.

TOPICS FOR STUDENT INDEPENDENT WORK

Methods of nuclear physics in medicine.

Radioactivity. Radionuclide diagnosis.

Modes of radioactive decay. Basic law of radioactive decay. Half-life time. Radiopharmaceuticals and requirements for them. Fundamentals of positron emission tomography.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allotted for independent work can be used by students for:

- preparation for lectures, practical and laboratory classes;
- preparation for the examination on the academic discipline;
- study of topics submitted for independent work;
- problems solving;
- fulfillment of research and creative tasks;
- preparation of thematic reports, essays, presentations;
- implementation of practical tasks;
- taking notes of educational literature;
- preparation of reports on laboratory works;
- compiling a review of scientific literature concerning the given topic;
- preparation of information and demonstration materials;
- compiling a thematic selection of literary sources, Internet sources.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

Main forms of supervised student independent work:
preparation and presentation of essays.

Control of supervised student independent work is carried out in the forms of:
tests;
discussion of essays.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competences assessment:

Oral form:

interview;

Written form:

tests;

reports;

essays;

Oral-written form:

examination;

Technical form:

electronic tests.

LIST OF AVAILABLE TEACHING METHODS

Traditional method (lecture, laboratory and practicals);

Active (interactive) methods:

Problem-Based Learning (PBL);

Research-Based Learning (RBL).

LIST OF PRACTICAL SKILLS

1. Measuring different physical characteristics of biological objects.
2. The use of the main measuring devices.
3. The use of separate samples of dental, therapeutic and diagnostic apparatus.
4. Application of modern informational technologies for processing and presentation of the measurement results.

LIST OF EQUIPMENT USED

1. computer;
2. laboratory holder;
3. length indicator;
4. optical microscope;
5. current power supply;
6. sound generator;
7. headphones;
8. audiometer;

9. Ostwald viscometer;
10. maximum bubble pressure measuring apparatus;
11. electrocardiograph;
12. pulse generator;
13. oscilloscope;
14. electrostimulator;
15. thermistor, thermocouple;
16. amplifier;
17. alternating current power supply;
18. galvanization apparatus;
19. dielectric plate with the electrodes;
20. milliammeter;
21. UHF therapy apparatus;
22. Darsonval apparatus;
23. polarimeter;
24. photoelectric colorimeter;
25. refractometer;
26. Goryaev's camera;
27. spectral device;
28. laser;
29. diffraction grating;
30. screen.

LIST OF LECTURES

1 semester

1. Fundamentals of biomechanics with aspects of materials science in dentistry.
2. Physical basis of hydro- and hemodynamics.

2 semester

1. Electric and magnetic phenomena in organism, electric effects and methods of investigation.
2. Optical methods of investigation and the interaction of the optical region radiation with biological objects.
3. X-radiation, its application in medicine.

LIST OF LABORATORY STUDIES

I semester

1. Determination of the elasticity modulus (Young's modulus) by the bending beam method.
2. Hardness determination using the Brinell, Vickers, and Knoop tests.
3. Thermal properties of dental materials and tooth tissues, their characteristics.
4. Physical and physiological characteristics of sound waves. Sound methods in medicine.
5. Viscosity of liquid and methods of its determination.
6. Principles of surface phenomena physics.

2 semester

1. Physical basis of tissue and organ electrography.
2. Electrostimulation of tissues and organs.
3. Devices for obtaining and recording medical data. Sensors.
4. Amplifiers of biopotentials.
5. Electric and magnetic properties of human body tissues. Physical basis of magnetic resonance imaging.
6. Electrical impedance of living tissue, its dependence on the alternating current frequency. The estimation of tissue viability.
7. Effect of electric current, electric and magnetic fields on human organism
8. Electromagnetic waves, its properties. Light polarization. Determination of the optically active substance concentration by polarimeter.
9. The light absorption and its laws.
10. Refractometry.
11. Optical microscopy.
12. Light reflection, absorption and scattering processes in skin, tooth tissues and dental materials.
13. Thermal radiation of bodies. Clinical thermography. Heat transfer of human body.
14. Light emission and absorption by atoms and molecules.
15. Luminescence. Application of luminescent methods in medicine.
16. Stimulated emission. Lasers and their medical applications.

LIST OF PRACTICAL STUDIES**1 semester**

1. Investigation of functional dependencies.
2. Principles of the error theory.
3. Physical basis of materials mechanics.
4. Principles of maxillofacial system biomechanics.
5. Origin and classification of acoustic waves.
6. Equation of continuity of flow. Ideal fluid, Bernoulli's equation.
7. Ultrasound and its application in medicine.
8. The main concepts and laws governing viscous fluid flow.
9. Physical basis of hemodynamics (hemorheology.)
10. Adhesion. Role of adhesion in dentistry.
11. Physical properties of biological membranes. Transport of substances across biological membranes.
12. Membrane cell potentials.

2 semester

13. Bremsstrahlung X-radiation, its origin and generation. X-radiation interaction mechanisms with matter. X-radiation application in medicine.

PROTOCOL OF THE CURRICULUM APPROVAL BY OTHER DEPARTMENTS

Title of the discipline requiring approval	Department	Amendments to the curriculum of the academic discipline	Decision of the department, which designed the curriculum
Radiation Medicine and Ecology	Radiation Medicine and Ecology Department	No amendments	Protocol # 10 of 18.05.2023

COMPILERS:

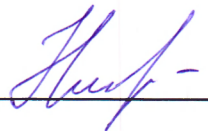
Associate Professor of the Medical and Biological Physics Department of the Educational Institution «Belarusian State Medical University», PhD., Associate Professor


A.A.Ivanov

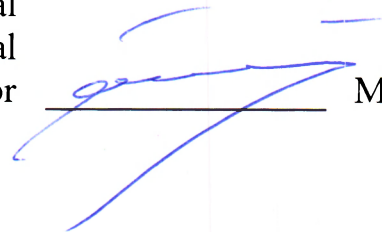
Associate Professor of the Medical and Biological Physics Department of the Educational Institution «Belarusian State Medical University», PhD., Associated Professor


N.I.Insarova

Associate Professor of the Medical and Biological Physics Department of the Educational Institution «Belarusian State Medical University», PhD., Associate Professor


N.A.Nikonenko

Head of the Medical and Biological Physics Department of the Educational Institution «Belarusian State Medical University», PhD., Associate Professor


M.V.Goltsev

Curriculum content, composition and accompanying documents comply with established requirements.


Dean of the Medical Faculty for International Students of the Educational Institution «Belarusian State Medical University»

26.06. 2023


O.S.Ishutin

Methodologist of the Educational Institution «Belarusian State Medical University»

26.06. 2023


S.V.Zaturanova