

AMENDMENTS AND CHANGES TO THE CURRICULUM IN THE EDUCATIONAL DISCIPLINE
«MEDICAL AND BIOLOGICAL PHYSICS»
for the specialty 7-07-0911-01 «GENERAL MEDICINE»

for 2024/2025 academic year

Amendments and changes	Basis/Reason
1. Changes have been introduced into the Explanatory Note (appendix 1)	Educational Plan for 2024/2025 academic year
2. Changes have been introduced into the Thematic Plan (appendix 2)	Educational Plan for 2024/2025 academic year
3. Changes have been introduced into the Educational Discipline Curricular Chart (appendix 3)	Educational Plan for 2024/2025 academic year

The curriculum is revised and approved at the department meeting of the department of Medical and Biological Physics
(protocol # 10 of 30.05.2024)

Head of the department of Medical and Biological Physics

M.V.Goltsev

APPROVED

Dean of the Medical Faculty for International Students

O.S. Ishutin

Section (topic) name	Number of class hours		
	lectures	practical	laboratory
membranes. Substance transport across biological membranes			
4.2. Formation of cell membrane potentials at rest and during its excitation. Generation and propagation of action potential along axons		4	-
5. Electrical and magnetic phenomena in the human body, electrical actions and examination methods	1,5	-	16
5.1. Physical basis of electrography of human tissues and organs. Fundamentals of electrocardiography	1,5	-	2
5.2. The use of direct and alternating current in medicine. Equivalent electrical circuit of living tissue. Physical basis of rheography		-	2
5.3. Principal physics of tissue and organ electrostimulation		-	2
5.4. Effect of high-frequency current and field on the human organism. Methods and equipment for high-frequency therapy		-	2
5.5. Obtaining and monitoring of biomedical information		-	4
5.6. Amplification of bioelectrical signals		-	4
6. Electromagnetic radiation, its use in medicine. Elements of the physics of atoms and molecules	4,5	9	13
6.1. Electromagnetic waves, their properties. Methods for obtaining polarized light. The use of polarization methods for the study of biological objects. Optical activity	1,5	-	2
6.2. Refractometry. Determination of the concentration of solutions using a refractometer. Principles of fiber optics. Fundamentals of endoscopy		-	2
6.3. Optical microscopy. Fundamentals of electron and scanning probe microscopy		-	2
6.4. Thermal radiation of bodies. Energy characteristics of thermal radiation. Infrared imagery and thermography in medicine		2	-
6.5. Laws of absorption and scattering of light. Fundamentals of photocalorimetry and	-	-	2

ACADEMIC DISCIPLINE CURRICULAR CHART

№ п/п	Section (topic) name	number of hours			supervised student independent work	Practical skills	Form of control	
		lectures	practical	laboratory			Of practical skills	of current / intermediate assessment
	I semester							
	Lectures	6	-	-	3			
1	Mechanical oscillations. Fourier theorem for processing diagnostic data. Mechanical waves. Bioacoustics. Biophysical basics of the acoustic sensation formation. Audiometry. Ultrasound and its properties. Acoustic methods of the investigations and treatments in medicine	1,5	-	-	1,5			
2	Physical basis of the hydrodynamics of ideal and viscous fluids. Biorheology and physical basis of hemodynamics. Viscometry. Factors affecting the blood viscosity in the body. Distribution of blood pressure in the cardiovascular system. Pulse wave. Heart work and heard power	1,5	-	-	-			written reports
3	Structure and physical properties of the biological membranes. Transport of substances through the biological membranes. Formation of the resting membrane potentials and generation of the action potential. Generation and propagation of the action potential along axons	1,5	-	-	-			

4	Physical basics of the electrography of tissues and organs of the human body. Fundamentals of electrocardiography. The use of direct and alternating current in medicine. Equivalent electrical circuit of living tissue. Physical basics of rheography	1,5	-	-	1,5			written reports
	Practical and laboratory lessons	-	36	-				
1.	Mathematical modelling of the biomedical process and medical data processing	-	-	4	-			
1.1	Fundamentals of differential calculus. Study of the functional relationships Laboratory work (L.w.) «Determination of the rates of function change and gradient of function. Elements of the errors theory»	-	-	2	-	Carrying out statistical processing of measurements	written account of laboratory work	Interview, written classroom (home) practical exercises, accounts of home practical exercises with oral defense, written account of laboratory work
1.2	Fundamentals of integral calculus. Methods of defining indefinite integrals. L.w. «Calculation of definite integrals»	-	-	2	-			Interview, written classroom (home) practical exercises, accounts of home practical exercises with oral defense, written account of laboratory work
2.	Fundamentals of biomechanics. Biomechanics of hearing. Acoustic research methods	-	2	4	-			
2.1	Mechanical properties of biological tissues. L.w. «Determining the elasticity modulus of materials»	-	-	2	-	Determining the elasticity modulus of materials by bending	written account of laboratory work	Interview, visual laboratory classes, control questioning, written account of laboratory work

2.2	Mechanical oscillations. Fourier theorem for processing diagnostic data. Mechanical waves	-	2	-	-		Interview, written classroom (home) practical exercises, accounts of home practical exercises with oral defense, control questioning, test
2.3	Bioacoustics. Ultrasound and its properties. Acoustic methods of the examination and treatment in medicine	-	-	-	-		Interview, written classroom (home) practical exercises, accounts of home practical exercises with oral defense, control questioning, test
2.4	Biophysical basis of the acoustic sensation formation. Audiometry L.w. «Registration of the spectral characteristics of ear sensitivity at the threshold of hearing»	-	-	2	-	Registration of the spectral characteristics of ear sensitivity at the threshold of hearing	Interview, electronic practicals, control questioning, written account of laboratory work
3.	Biorheology. Physical basis of hemodynamics. Elements of surface phenomena physics	-	4	4	-		
3.1	Physical basis of hydrodynamics of ideal and viscous fluids	-	2	-	-		Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
3.2	Biorheology and physical basis of hemodynamics	-	2	-	-		Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
3.3	Viscometry L.w. «Determination of the liquid viscosity with an Ostwald viscometer»	-	-	2	-	Determination of the liquid viscosity with an Ostwald viscometer	Visual laboratory classes, interview, control questioning, written account of laboratory work
3.4	Liquid surface tension. Capillary phenomena	-	-	2	-	Determination of the surface tension	Visual laboratory classes, interview,

	L.w. «Determination of the surface tension by maximum bubble pressure method»						by maximum bubble pressure method	work	control questioning, written account of laboratory work
4.	Transport phenomena and physical processes in biological membranes. Cell membrane potentials	-	5	-	-				
4.1	Structure and physical properties of biological membranes. Substance transport across biological membranes	-	1	-	-				Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
4.2	Formation of cell membrane potentials at rest and during its excitation. Generation and propagation of action potential along axons	-	2	-	-				Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
	Final lesson on topics «Fundamentals of biomechanics. Biomechanics of hearing. Acoustic research methods», «Biorheology. Physical basis of hemodynamics. Elements of physics of surface phenomena», «Transport phenomena and physical processes in biological membranes. Cell membrane potentials»	-	2	-	-				Colloquium*. Electronic tests
5	Electrical and magnetic phenomena in the human body, electrical actions and examination methods	1,5	16						
5.1	Physical basis of electrography of human tissues and organs. Fundamentals of electrocardiography L.w. «Physical basis of electrography of	-	-	2	-		The use of electrocardiograph to record an electrocardiogram	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of

	human tissues and organs»					(ECG) in three standard leads. Determining the main characteristics of an ECG		laboratory work
5.2	The use of direct and alternating current in medicine. Equivalent electrical circuit of living tissue. Physical basis of rheography L.w. «Determination of the dependence of biological tissue impedance on current frequency»	-	-	2	-	Determination of the dependence of biological tissue impedance on current frequency	written account of laboratory work *	Visual laboratory classes, interview, control questioning, written account of laboratory work
5.3	Principal physics of tissue and organ electrostimulation L.w. «The study of electrostimulation basis»	-	-	2	-	Study of pulse current parameters	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work
5.4	Effect of high-frequency current and field on the human organism. Methods and equipment for high-frequency therapy L.w. «Physical principles of high-frequency electrotherapy»	-	-	2	-	The use of some high-frequency physiotherapy equipment (UHF therapy and local darsonvalization apparatus)	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work
5.5	Obtaining and monitoring of biomedical information L.w. «Temperature sensors»	-	-	2	-	Determine the characteristics of electrical sensors	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work
	Final lesson on topics: «Mathematical modelling of the biomedical process and medical data processing», «Fundamentals of biomechanics. Biomechanics of hearing. Acoustic research methods», «Biorheology. Physical basis of hemodynamics. Elements of surface phenomena physics», «Transport phenomena and physical processes in	-	-	2	-			Assessment based on a module-rating system. Credit

	biological membranes. Cell membrane potentials», «Electrical and magnetic phenomena in the human body, electrical actions and examination methods»									
	2 Semester									
	Lectures									
1	Electromagnetic waves, their properties. Methods for obtaining polarized light. The use of polarization methods for the study of biological objects. Optical activity. Thermal radiation of bodies. Energy characteristics of thermal radiation. Infrared imagery and thermography in medicine.	6	-	-	-					
2	Emission and absorption of energy by atoms and molecules. Fundamentals of spectral analysis. Emission and absorption spectra. Luminescence. Basic characteristics and laws of luminescence. Stimulated emission. Lasers. Properties of laser radiation. The use of lasers in medicine.	1,5	-	-	-					
3	Bremsstrahlung and characteristic X-rays. Properties of X-rays. X-rays interaction with matter. Physical principles of X-ray diagnostics. The use of X-rays in radiation therapy. Fundamentals of X-ray computed tomography. Methods of X-ray protection.	1,5	-	-	-					
4	Radioactivity. Artificial and natural radioactivity. Interaction of ionizing radiation with matter. Radiation dosimetry. Registration methods of ionizing radiation	1,5	-	-	-					
	Practical and laboratory lessons	-	34	-	-					
5.6	Amplification of bioelectrical signals L.w. «The study of the properties of electrical signals amplifier»	-	-	2	-			The study of the properties of electrical signals amplifier	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work

	Final lesson on topic «Electrical and magnetic phenomena in the human body, electrical actions and examination methods»	-	-	2	-				Colloquium*. Electronic tests
6	Electromagnetic radiation, its use in medicine. Elements of the physics of atoms and molecules	4,5	9	13	-				
6.1	Electromagnetic waves, their properties. Methods for obtaining polarized light. The use of polarization methods for the study of biological objects. Optical activity L.w. «Polarimeter use to determine the concentration of optically active substances»	-	-	2	-		Polarimeter use to determine the concentration of optically active substances	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work
6.2	Refractometry. Determination of the concentration of solutions using a refractometer. Principles of fiber optics. Fundamentals of endoscopy L.w. «Determination of the liquid refractive index with a refractometer»	-	-	2	-		Determination of the liquid refractive index with a refractometer	written account of laboratory work *	Visual laboratory classes, interview, control questioning, written account of laboratory work
6.3	Optical microscopy. Fundamentals of electron and scanning probe microscopy L.w. «Measuring the small objects size with a microscope»	-	-	2	-		Measuring the small objects size with a microscope	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work
6.4	Thermal radiation of bodies. Energy characteristics of thermal radiation. Infrared imagery and thermography in medicine	-	2	-	-				Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning,

											essay, test
6.5	Laws of absorption and scattering of light. Fundamentals of photocolrimetry and spectrophotometry L.w. «Absorption and scattering of light. Fundamentals of colorimetric analysis»	-	-	2	-	The use of a single-beam photoelectrocolori meter (PEC) to measure the transmittance and optical density of colored solutions to determine their concentration	written account of laboratory work *	Visual laboratory classes, interview, control questioning, written account of laboratory work			
6.6	Emission and absorption of energy by atoms and molecules. Fundamentals of spectral analysis. Emission and absorption spectra L.w. «Fundamentals of spectral analysis»	-	-	2	-	Registration of absorption and emission spectra of a substance	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work			
6.7	Luminescence. Basic characteristics and laws of luminescence L.w. «Fundamentals of spectral analysis»			2		Registration of absorption and emission spectra of a substance	written account of laboratory work	Written classroom (home) practical exercises, interview, control questioning, essay, test, written account of laboratory work			
6.8	Stimulated emission. Lasers. Properties of laser radiation. The use of lasers in medicine L.w. «The principle of lasers operation, their properties and applications»	-	-	2	-	Determination of the laser wavelength radiation using a diffraction grating	written account of laboratory work	Visual laboratory classes, interview, control questioning, written account of laboratory work			
6.9	Biophysical foundations of vision							Written classroom (home) practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test			

	Final lesson on topic «Electromagnetic radiation, its use in medicine. Elements of the physics of atoms and molecules»	-	2	-	-		Colloquium*. Electronic tests
6.10	Bremsstrahlung and characteristic X-rays. Properties of X-rays and its use in medicine	-	2	-	-		Written home practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
	Bremsstrahlung and characteristic X-rays. Properties of X-rays. X-rays interaction with matter. Physical principles of X-ray diagnostics. The use of X-rays in radiation therapy. Fundamentals of X-ray computed tomography. Methods of X-ray protection	1,5	-	-	-		
7	Methods of nuclear physics in medicine	-	6	2	-		Written home practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
7.1	Radioactivity. Artificial and natural radioactivity. Interaction of ionizing radiation with matter	-	2	-	-		Written home practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test
7.2	Radiation dosimetry. Registration methods of ionizing radiation L.w. «Determination of the specific mass activity of food and building materials using a radiometer»	-	-	2	-	Carrying out dosimetric monitoring. written account of laboratory work	Written home practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test, written account of laboratory work

7.3	Magnetic resonance tomography. Radionuclide methods of diagnostics and radiotherapy. Positron-emission tomography	-	2	-	-		Written home practical exercises, accounts of home practical exercises with oral defense, interview, control questioning, essay, test, written account of laboratory work
	Final lesson on topics «Electromagnetic radiation, its use in medicine. Elements of the physics of atoms and molecules», «Methods of nuclear physics in medicine»	-	2	-	-		Colloquium*. Electronic tests. Exam
	Total hours:	12	26	44	3		

*This is a mandatory form of current certification